INSTALLATION RESTORATION PROGRAM

PRELIMINARY ASSESSMENT/ SITE INSPECTION REPORT

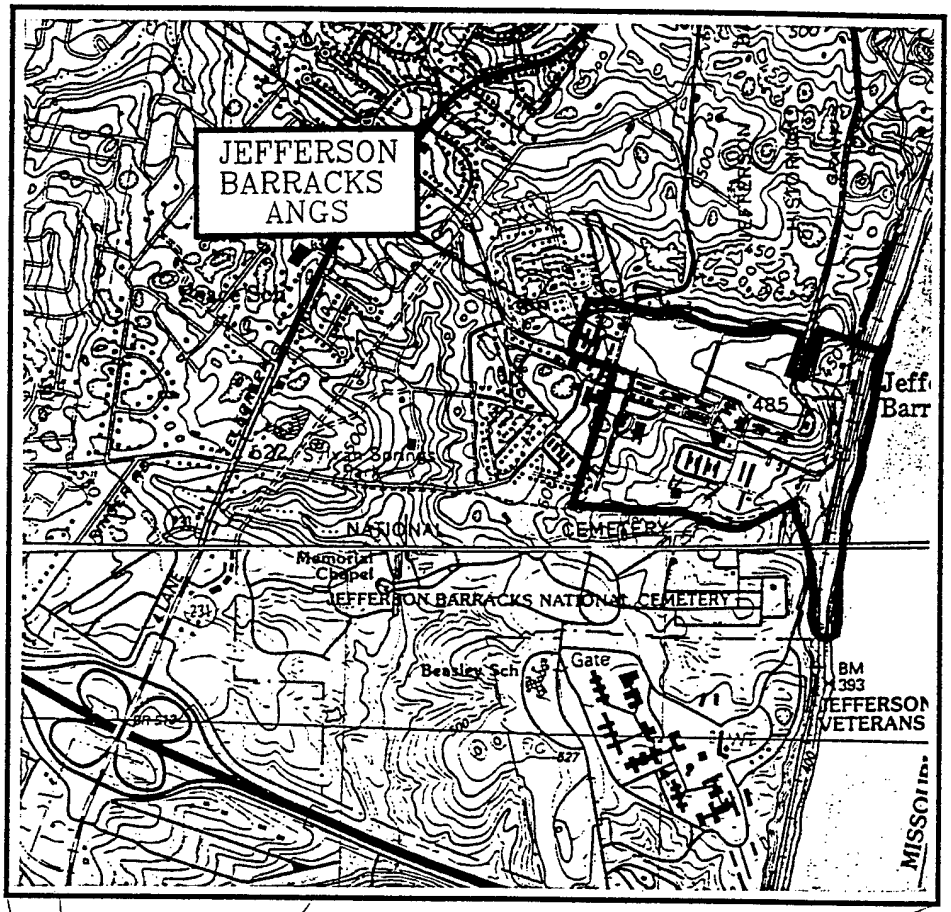
VOLUME I

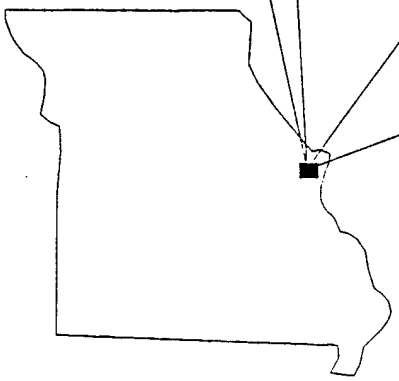
157th AIR CONTROL GROUP
JEFFERSON BARRACKS
AIR NATIONAL GUARD
MISSOURI AIR NATIONAL GUARD
ST. LOUIS, MISSOURI

MARCH 1997

Prepared For

ANGRC/CEVR
ANDREWS AFB, MARYLAND





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SITE LOCATION IN THE STATE OF MISSOURI

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

OPTECH
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MARCH 1995

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13. ABSTRACT (Maximum 200 words)

This PA/SI Report presents information on potentially contaminated areas identified in the PA process as Areas of Concern (AOC's) at the 157th Air Control Group (ACG), Jefferson Barracks ANGS, St. Louis, MO. The Air National Guard Readiness Center/Installation Restoration Branch (ANGRC/CEVR) authorized OpTech to prepare the PA/SI Report. Work on the PA began in November 1993. Information obtained through interviews, review of station records, and field observations resulted in the identification of four potentially contaminated disposal and/or spill areas (AOC's). The four AOC's identified include the Disposal Area (AOC-A), Storage Area (AOC-B), Drainage Ditch (AOC-C), and Waste Oil Dump (AOC-D). These AOC's were investigated, using screening and confirmation activities, to determine if contamination exists that justifies further investigation as an IRP site. Considering the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-A, AOC-C, and AOC-D. At AOC-B additional investigation is recommended because the vertical and areal extent of TPH contamination is in excess of MDNR cleanup guidelines. In addition, the PA/SI Report recommended a risk-based evaluation to determine action levels for PAH impacted surface soils at AOC-B.

The MDNR concurred with the recommendations of this report.

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LIST OF ACRONYMS

ACG	Air Control Group
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ANGRC/CEVR	Air National Guard Readiness Center/Installation Restoration Branch
ANGB	Air National Guard Base
ANGS	Air National Guard Station
AOC	Area of Concern
ARNG	Army National Guard
ARARs	Applicable or Relevant and Appropriate Requirements
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Material
ATHA	Ambient temperature headspace analysis
BLS	Below land surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
cc	Cubic Centimeter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CME	Central Mining Equipment
CSR	Code of State Regulations
CWA	Clean Water Act
DCE	Dichloroethylene
DERA	Defense Environmental Restoration Account
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DOT	Department of Transportation
DRMO	Defence Reutilization and Marketing Office
Ft	Feet
GC	Gas Chromatograph
GEEIA	Ground Electronic Engineering Installation Agency
GPR	Ground Penetrating Radar
HM/HW	Hazardous Materials/Hazardous Wastes
HRS	Hazard Ranking System
HSA	Hollow Stem Auger
IRP	Installation Restoration Program
MDNR	Missouri Department of Natural Resources
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
NEI	NyTest Environmental, Incorporated
ns	Nanosecond
OMS	Organizational Maintenance Squadron
OpTech	Operational Technologies Corporation
OWS	Oil/Water Separator
PA	Preliminary Assessment

LIST OF ACRONYMS (Concluded)

PA/SI	Preliminary Assessment/Site Investigation
PAH	Polyaromatic Hydrocarbons
PC	Peer Consultants
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethylene
PID	Photoionization Detector
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
ppmV	Parts per Million, Vapor
PVC	Polyvinyl Chloride
PZ	Piezometer
QA/QC	Quality Assurance/Quality Control
SARA	Superfund Amendments and Reauthorization Act
SGS	Soil Gas Survey
SI	Site Inspection
SIR	Subsurface Interface Radar
SVOC	Semivolatile Organic Compounds
TCE	Trichloroethylene
TCLP	Toxic Characteristic Leaching Procedure
TCS	Tactical Control Squadron
TPH	Total Petroleum Hydrocarbons
μg/kg	Micrograms per Kilogram
μg/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound

INSTALLATION RESTORATION PROGRAM PRELIMINARY ASSESSMENT/SITE INSPECTION

EXECUTIVE SUMMARY

ES 1.0 INTRODUCTION

A Preliminary Assessment/Site Inspection (PA/SI) was conducted at the 157th Air Control Group (ACG), Jefferson Barracks Air National Guard Station (ANGS), St. Louis, Missouri. The Air National Guard Readiness Center/Installation Restoration Branch (ANGRC/CEVR) authorized Operational Technologies Corporation (OpTech) to prepare a PA/SI Work Plan and conduct the SI at the Jefferson Barracks ANGS. A Preliminary Assessment (PA) of the 157th ACG, Jefferson Barracks ANGS, was initiated by ANGRC and OpTech personnel in November 1993. Information obtained through interviews, review of station records, and field observations resulted in the identification of four potentially contaminated disposal and/or spill areas.

A potentially contaminated area identified in the PA process is termed an Area of Concern (AOC). The AOC is investigated, using screening and confirmation activities, to determine if contamination exists that justifies further investigation as an Installation Restoration Program (IRP) site. The four AOCs identified at the Jefferson Barracks ANGS are the Disposal Area AOC (AOC-A), Storage Area AOC (AOC-B), Drainage Ditch AOC (AOC-C), and Waste Oil Dump AOC (AOC-D). The SI was conducted as outlined in the PA/SI Work Plan submitted to ANGRC/CEVR in October 1994. The field work commenced at the 157th ACG on 5 December 1994 and was completed on 15 December 1994.

The purpose of the SI is to determine if contamination is present at each AOC, if contaminants are detected, and if concentrations warrant further investigation as an IRP site.

Specifically excluded from the PA/SI scope were the following:

- Underground storage tank sites that were not identified prior to 1 January 1994. These sites are not eligible for Defense Environmental Restoration Account (DERA) Funds.

- Contamination at unit that has not occurred until recently. Examples include the recently discovered underground storage tank (UST) near the Building 75

washrack, a former washrack near Building 531, and the old post filling station. These sites are not eligible for DERA Funds.

- Property located outside of areas administered by the ANG;

- Divested property formerly owned by the Federal government. These properties are the responsibility of the Army Corp of Engineers (COE).

- ANG administered property leased to another government agency. In such cases the lessee is responsible for assessment of the property.

- Areas where unexploded ordinance (UXO) had been handled or disposed. UXO investigation and remediation at the station is the responsibility of the COE.

The SI was accomplished at Jefferson Barracks ANGS by conducting a soil gas survey and drilling soil borings to collect subsurface soil samples for analysis at the four AOCs. A geophysical survey was conducted at AOC-A and AOC-D to provide information on possible buried sources of contamination, and to verify no subsurface structures or hazards to drilling were present based on historical information obtained during the PA. Three piezometers were planned as part of SI activities to determine groundwater flow direction in the vicinity of the AOCs. During drilling, however, groundwater was not encountered above the bedrock in the majority of borings and at the direction of the ANGRC, piezometers were not installed.

A total of 14 soil borings were drilled at the AOCs to obtain soil samples for field screening and subsurface geological characterization. A total of 37 soil samples and three surface sediment samples were submitted for AOC-specific analytical programs that included analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and total metals. Soil samples from the AOCs were field-screened using a photoionization detector (PID) and a field gas chromatograph (GC), and were subsequently analyzed for laboratory parameters related to the suspected contaminants identified in the PA.

ES 2.0 AREAS OF CONCERN

2.1 DISPOSAL AREA AOC (AOC-A)

A total of nine soil samples were submitted for laboratory analysis for SVOCs, TPH, and total metals. One SVOC, bis(2-ethylhexyl)phthalate, was detected at 720 micrograms per kilogram

(μg/kg) in one sample; however, this was attributed to laboratory-induced contamination (United States Environmental Protection Agency (USEPA), 1993). Total metals concentrations detected at AOC-A were comparable to naturally-occurring background levels in east-central Missouri soils (Schacklette and Boerngen, 1984). TPH were not detected in any sample from this AOC. Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-A.

2.2 STORAGE AREA AOC (AOC-B)

A total of 12 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and total metals. SVOCs were detected in two soil samples from this AOC. The SVOCs detected were polyaromatic hydrocarbons (PAHs), and concentrations ranged from 240 to 2,500 μg/kg. Missouri Department of Natural Resources (MDNR) has not established action levels for PAH contamination and determines cleanup requirements on a case-by-case basis. The two samples where PAH contamination was detected occurred in the surface sample interval: B-003BH (1.0-2.5) and B-004BH (0.5-2.0). The second sample interval analyzed from these locations, B-003BH (5.0-6.5) and B-004BH (10.0-11.5), contained no detectable concentrations of PAH compounds, therefore indicating a limited areal and vertical extent of contamination.

TPH were detected at AOC-B at a maximum concentration of 440 milligrams per kilogram (mg/kg) in one sample. Using the Missouri Site Characterization Guidance Document (MDNR, 1991), the calculated soil cleanup guidelines for leaking underground storage tanks (USTs) is 200 parts per million (ppm). Only this one sample from B-001BH (3.5-5.0) exceeded the soil cleanup guidelines.

Total metals concentrations detected at AOC-B were all within naturally-occurring background levels in soils (Schacklette and Boerngen, 1984) except for copper, nickel and zinc. These three metals slightly exceeded background range values and may reflect elevated natural background conditions since historical activities at the site do not include copper, nickel or zinc as potential contaminants.

Inspection results indicated TPH exceeded MDNR cleanup standards for leaking USTs in one sample from B-001BH. Since this boring was drilled in the northeast portion of the site, and the next investigative sample from that boring was obtained from 10.0-11.5 feet below land surface (BLS), the vertical and areal extent of TPH has not been defined. In order to characterize the vertical and areal extent of TPH contamination in excess of MDNR cleanup

guidelines, additional investigation is required at the B-001BH location. A risk-based evaluation to determine action levels for PAH impacted soil at the site is warranted.

2.3 DRAINAGE DITCH AOC (AOC-C)

A total of 10 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and total metals. Five metals detected at AOC-C exceeded naturally-occurring background levels in soils (Schacklette and Boerngen, 1984). These metals (antimony, chromium, copper, nickel, and zinc) may represent slightly elevated natural background levels. VOCs, SVOCs, and TPH were not detected in soil or sediments from any sample at this AOC. Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-C.

2.4 WASTE OIL DUMP (AOC-D)

A total of six soil samples were submitted for laboratory analysis for SVOCs, TPH, and total metals. Metals concentrations detected at AOC-D were all within naturally-occurring background levels in soils (Schacklette and Boerngen, 1984) except for nickel and zinc. These two metals slightly exceeded background range values and may reflect slightly elevated natural background conditions since historical activities at the site do not include nickel and zinc as potential contaminants. SVOCs and TPH were not detected in soil samples at this AOC. Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-D.

SECTION 1.0 INTRODUCTION

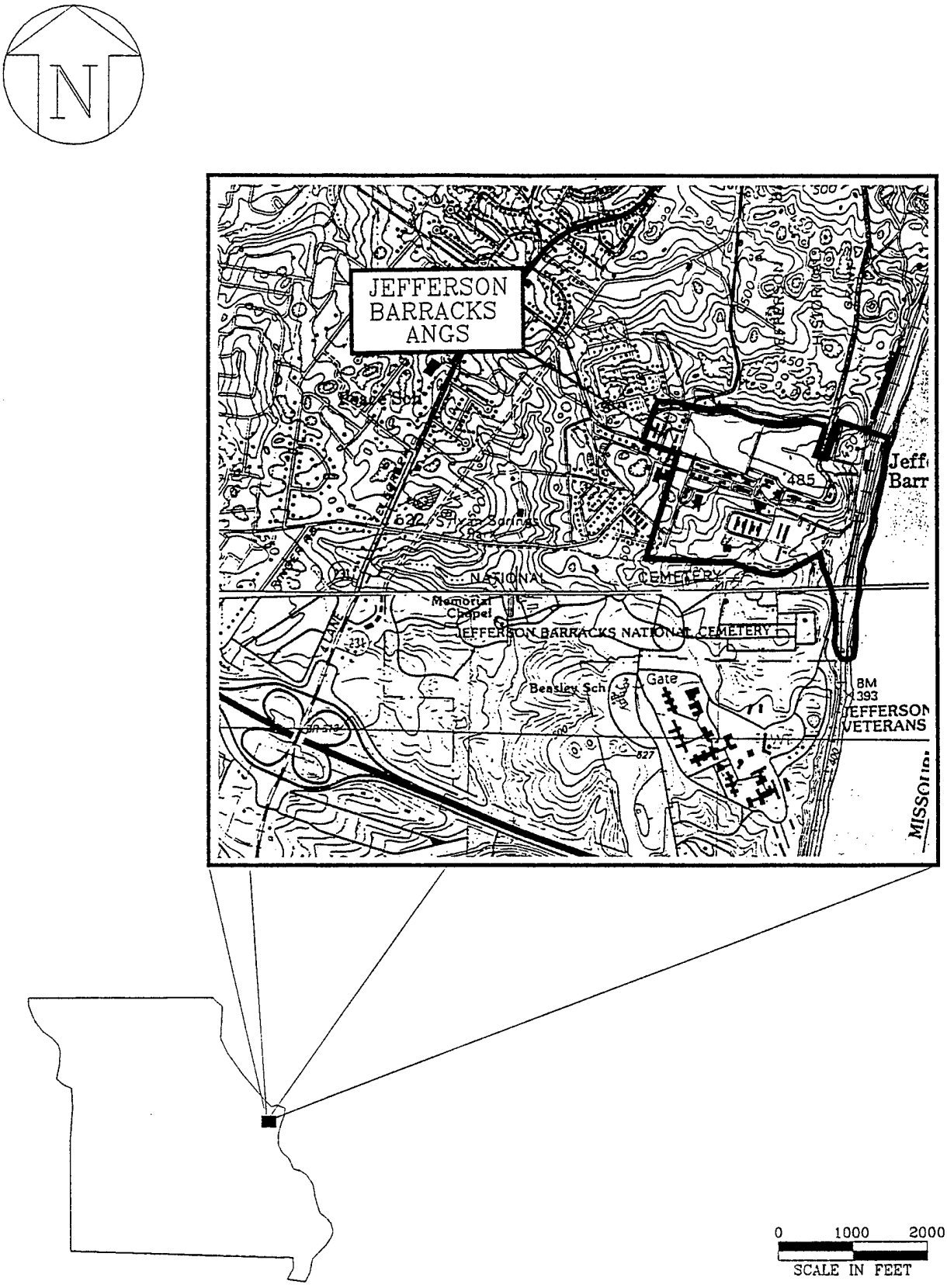
1.1 BACKGROUND

This Preliminary Assessment/Site Inspection (PA/SI) Report presents the results of inspection activities conducted at the 157th Air Control Group (ACG), Jefferson Barracks Air National Guard Station (ANGS), St. Louis, Missouri (see Figure 1.1). The Air National Guard Readiness Center/Installation Restoration Branch (ANGRC/CEVR) authorized Operational Technologies Corporation (OpTech) to prepare a PA/SI Work Plan and conduct the Site Inspection (SI) at the Jefferson Barracks ANGS. A Preliminary Assessment (PA) of the 157th ACG, Jefferson Barracks ANGS, was initiated by Air National Guard Readiness Center (ANGRC) and OpTech personnel in November 1993. Information obtained through interviews, review of station records, and field observations resulted in the identification of four potentially contaminated disposal and/or spill areas, or Areas of Concern (AOCs). AOCs are investigated, using screening and confirmation activities, to determine if contamination exists that justifies further investigation as an Installation Restoration Program (IRP) site. These areas of concern are designated as the Disposal Area AOC (AOC-A), Storage Area AOC (AOC-B), Drainage Ditch AOC (AOC-C), and Waste Oil Dump AOC (AOC-D). The SI was conducted as outlined in the PA/SI Work Plan approved by ANGRC/CEVR in October 1994. The PA/SI is conducted under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

The Defense Environmental Restoration Program (DERP) was established in 1984 to promote and coordinate efforts for the evaluation and cleanup of contamination at Department of Defense (DoD) installations. On 23 January 1987, Presidential Executive Order 12580 was issued which assigned the responsibility to the Secretary of Defense for carrying out DERP within the overall framework of SARA and CERCLA. The IRP was established under DERP to identify, investigate, and clean up contamination at installations. The IRP is focused on cleanup of contamination associated with past DoD activities to ensure that threats to public health are minimized and to restore natural resources for future use. The ANGRC manages the IRP and related activities for Air National Guard (ANG) installations.

The six phases of the IRP program are:

Preliminary Assessment – The purpose of the PA is to identify AOCS that may pose a hazard to public health or the environment as a result of past spills or disposal practices



SOURCE: U.S. GEOLOGICAL SURVEY, 7.5-MINUTE SERIES TOPOGRAPHIC MAP-OAKVILLE QUADRANGLE MAP

FIGURE 1.1

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SITE LOCATION IN THE
STATE OF MISSOURI
157th ACG, Jefferson Barracks ANGS
St.-Louis, Missouri

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at the station, or that may have an adverse effect by the persistence of contaminants in the environment.

Specifically excluded from the PA/SI scope were the following:

- Underground storage tank sites that were not identified prior to 1 January 1994. These sites are not eligible for Defense Environmental Restoration Account (DERA) Funds.

- Contamination at unit that has not occurred until recently. Examples include the recently discovered underground storage tank (UST) near the Building 75 washrack, a former washrack near Building 531, and the old post filling station. These sites are not eligible for DERA Funds.

- Property located outside of areas administered by the ANG;

- Divested property formerly owned by the Federal government. These properties are the responsibility of the Army Corp of Engineers (COE).

- ANG administered property leased to another government agency. In such cases the lessee is responsible for assessment of the property.

- Areas where unexploded ordinance (UXO) had been handled or disposed. UXO investigation and remediation at the station is the responsibility of the COE.

Site Investigation – A Site Investigation (Inspection) is conducted to confirm the presence or absence of environmental contamination and to assess the risks to potential receptors, either human or environmental.

Remedial Investigation – A Remedial Investigation (RI) is performed for each site requiring continuing investigation to quantify and qualify prior findings, and to provide a basis for the Feasibility Study (FS). The RI will include a Work Plan, field investigation, risk assessment, and a Final Report. An RI is often an iterative process; further investigation may be required to adequately support a choice of action alternatives or provide sufficient information for an FS.

Feasibility Study – The FS is performed to choose the most advantageous remediation method from among practical alternatives. Selection of remediation methods is based on engineering feasibility, protectiveness of public health and the environment, regulatory requirements, and cost. The FS includes development of alternative remediation techniques, screening of these alternatives, a detailed analysis of plausible alternatives, an environmental assessment of these alternatives, selection of the preferred alternative, and preparation of a report documenting these selections and the selection rationale. In addition, a Record of Decision is prepared that records the recommended action required.

Remedial Design – If remediation is required, Remedial Design (RD) will be initiated. The RD consists of plans and specifications to implement the selected Remedial Action.

Remedial Action – Remedial Action (RA) is the cleanup phase of the IRP and will be implemented as specified in the RD.

1.2 PURPOSE

The overall objective of the PA/SI was to identify and evaluate potential AOCs associated with past waste handling procedures, disposal and spill areas. This objective has been met through the PA and SI activities. The PA consisted of personnel interviews and a records search designed to identify and evaluate past disposal and/or spill areas that might pose a potential and/or actual hazard to public health, public welfare, or the environment. The SI consisted of field activities designed to confirm the presence or absence of contamination at the AOCs identified in the PA. In addition, this PA/SI Report provides specific information required to complete the Hazard Ranking System (HRS) "Data Requirements for Federal Facility Docket Sites".

The specific objectives of the PA/SI were to:

- Identify all potential AOCs at the station under control of the ANG, based on a critical evaluation of past waste handling and disposal practices, or reasonable evident of spillage.

- Obtain available geological, hydrological, meteorological, and environmental data to define hydrogeologic conditions that affect contaminant migration, containment, or cleanup.

- Provide data to assist in determining the presence, type, magnitude, or absence of contamination at AOCs.

- Support site-specific decisions, such as no further action or identification of those AOCs requiring further investigation.

1.3 SCOPE

The scope of the PA included the gathering and evaluation of information pertaining to historic waste handling and disposal practices at the station, while the SI included screening activities for the presence of possible contamination at AOCs identified during the PA. The scope was limited to physical areas under the primary control of Jefferson Barracks ANGS. Also, the scope was limited in that the extent of contamination at AOCs and the extent of possible threats to human health and the environment were not determined during this PA/SI. Therefore, within these limits, the PA/SI included the following actions: the identification of AOCs at or under primary control of the ANGS and the evaluation of potential receptors; the definition of the nature of releases at identified AOCs; the confirmation of the absence or presence of soil contamination; and description of the geologic conditions of the installation study area, including the subsurface soil types and the presence or absence of hydrogeologic confining layers. The results of this PA/SI provide the technical basis needed to reach a decision point for each AOC.

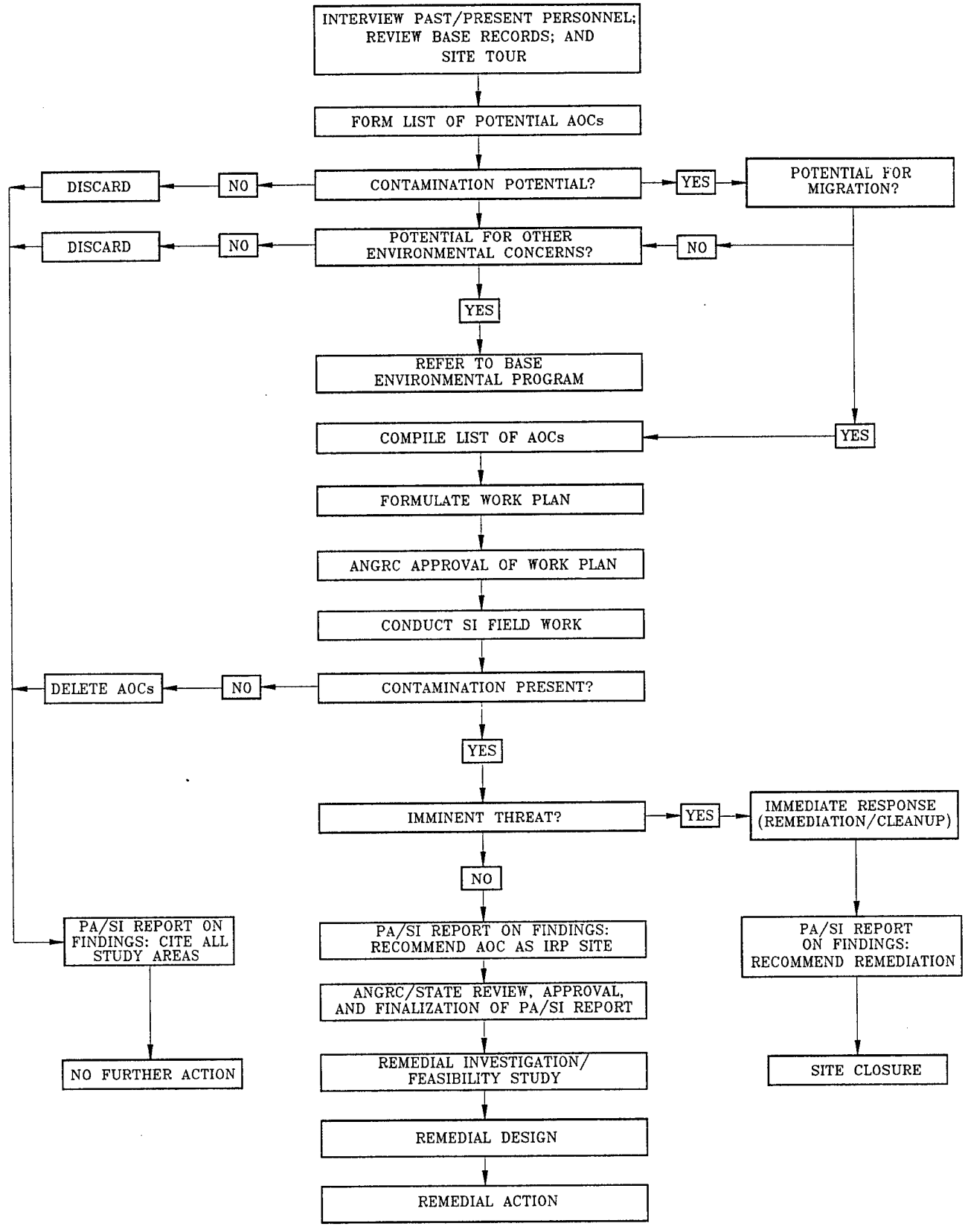
1.4 METHODOLOGY

A flow chart of the IRP process is presented in Figure 1.2.

1.4.1 Preliminary Assessment Process

The purpose of the PA is to identify and evaluate the historical use, disposal, or release of hazardous materials and hazardous wastes (HM/HW) in areas controlled by the Missouri Air National Guard that may pose a potential or actual hazard to public health, public welfare, or the environment. The PA specifically addresses facilities and units administered by the ANG Installation Restoration Program (IRP).

The PA began with a visit to Jefferson Barracks ANGS to evaluate both past and present HM/HW handling procedures and past disposal practices. The evaluation of past HM/HW handling practices was facilitated by interviews with ten station personnel and telephone interviews with 30 retirees and former station personnel familiar with the various operating



SOURCE: MODIFIED FROM ANGRC/CEVR, 1994.

FIGURE 1.2

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IRP PROCESS FLOW DIAGRAM

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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procedures at the station. These interviews identified areas at the station where HM/HW was stored, spilled, disposed of, or released into the environment.

Historic records from station files were collected and reviewed to supplement the information obtained from the interviews. Using this information, a list of four past waste spill/disposal areas on the station was compiled for further evaluation. A general survey tour of the identified spill/disposal areas and the station was conducted to determine the presence of visible contamination and to help assess the potential for contaminant migration. Particular attention was given to locating nearby drainage ditches, surface water bodies, and residences.

Detailed geological, hydrological, meteorological, developmental (land use and zoning), and environmental data for the Jefferson Barracks area were also obtained from appropriate Federal, state, and local agencies. Following a detailed analysis of all the information obtained, four AOCs were identified, described in detail, and recommended for SI activities included in the PA/SI Work Plan.

1.4.2 Site Inspection Process

The purpose of the SI was to perform field activities to confirm the presence or absence of contamination at each of the identified AOCs. The SI was accomplished at Jefferson Barracks ANGS by conducting a soil gas survey and installing soil borings at the four AOCs to collect subsurface soil samples. Additionally, three surface sediment samples were collected for laboratory analysis from the Drainage Ditch AOC. These samples were field screened using a photoionization detector (PID) and a field gas chromatograph (GC), and were submitted for laboratory analyses to test for suspected contaminants identified in the PA. The findings of both the initial PA station visit and the SI field activities are presented in this PA/SI Report.

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SECTION 2.0 INSTALLATION DESCRIPTION

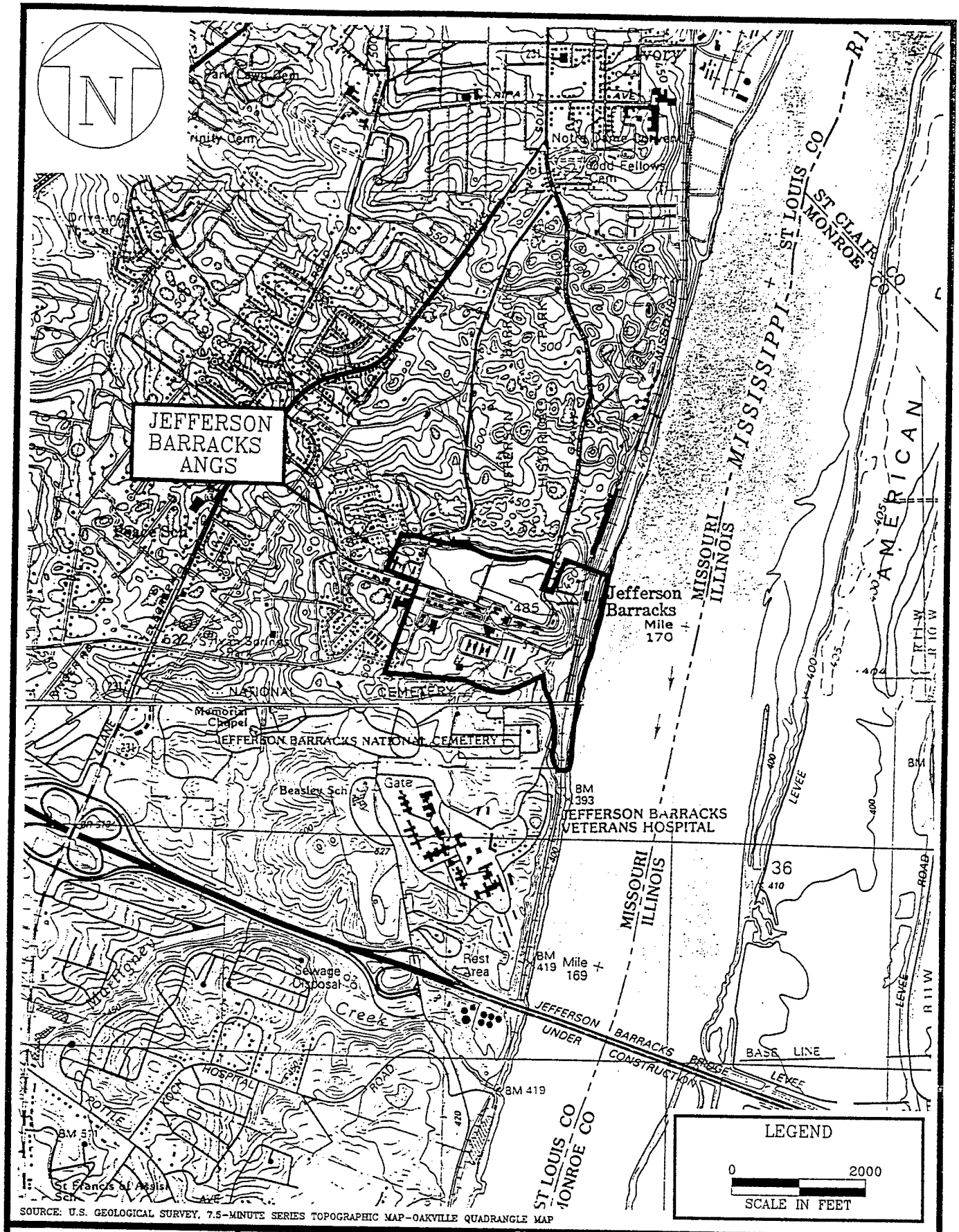
2.1 LOCATION

Jefferson Barracks ANGS is located along the western bank of the Mississippi River, approximately 10 miles south of the city of St. Louis, in St. Louis County, Missouri. The station occupies approximately 135 acres and is bordered by the Mississippi River on the east, a County park on the north, a national veterans cemetery on the south, and an apartment complex on the west (see Figure 2.1). The main entrance to the installation is through the west gate. Jefferson Barracks is located within the United States Survey No. 3341, Township Forty-Four (44) North, Ranges Six (6) and Seven (7) East of the 5th Principal Meridian.

Currently stationed at Jefferson Barracks ANGS are several Air National Guard Units including Headquarters 157 Air Control Group, 218 Engineering Installation Squadron, 121 Air Control Squadron, and a Civil Engineering detachment. Also located at Jefferson Barracks are several Army National Guard (ARNG) units, components of the U. S. Army Reserve, National Guard Bureau Human Resources (eastern division), Defense Fuels Supply, and the U. S. Coast Guard. A full-time work force of approximately 140 people support the station's total unit training assembly population of over 2,000 soldiers.

2.2 ORGANIZATION AND HISTORY

On 10 July 1826, troops of the U. S. First Infantry Regiment encamped at the site later known as Jefferson Barracks. The military reservation of Jefferson Barracks was established on the edge of a vast expanse of wilderness known as the Louisiana Purchase. At its beginning, Jefferson Barracks was the largest military reservation in the country, covering over 1,700 acres and stretching 2 miles along the west bank of the Mississippi River. Jefferson Barracks was the first basic training camp of the U. S. Army and the home of the First U. S. Cavalry. Throughout its history, Jefferson Barracks served as a U. S. Ordnance Depot, U. S. Army Engineers Depot, the largest U. S. Army General Hospital, U. S. Naval Munitions Storage Depot, Induction and Separation Center, National Guard Mobilization Headquarters, Army Air Corps School, and as a training base. During the 1800s Jefferson Barracks consisted mainly of stone or wooden buildings. An extensive rebuilding program took place between 1890 and 1905, replacing the original stone and wooden buildings with red brick structures which are still in use today. During World War I, Jefferson Barracks was designated as a clearing house for recruits. With the advent of World War II, there was a large increase in the population of



SOURCE: U.S. GEOLOGICAL SURVEY, 7.5-MINUTE SERIES TOPOGRAPHIC MAP-OAKVILLE QUADRANGLE MAP

FIGURE 2.1

P\JEFFERSN\TOPO

7.5' TOPOGRAPHIC MAP

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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Jefferson Barracks. Numerous temporary facilities and temporary wooden buildings were constructed to accommodate this population increase.

On 30 June 1946, Jefferson Barracks was deemed unfavorable for use as a training site for a large modern army and was declared surplus and erased from the muster roles as an active post. Elements of the Missouri National Guard then moved on the base. On 8 June 1950, a tract of land containing 135 acres was transferred to the State of Missouri for use in training and maintaining reserve (National Guard) components of the armed forces. Hence, the former 1,700 acres of military reservation was reduced to 135 acres. In 1952, Missouri Guard units at Jefferson Barracks included the Air National Guard's HQ 157th Tactical Control Group, 181st Tactical Control Squadron (TCS), two Ground Electronic Engineering Installation Agency Squadrons (GEEIA) and Army National Guard Organizational Maintenance Companies which provided vehicle maintenance to ARNG units in the St. Louis area. By 1970, most ARNG units in the St. Louis area had moved to Jefferson Barracks, and the majority of maintenance activities at Jefferson Barracks were related to vehicle maintenance support of ARNG combat units.

In order for the Air Force to provide funds for the construction and maintenance of facilities used by the ANG at Jefferson Barracks, it required that the property be leased back to the Federal Government for a long term (at least 20 years). This lease was signed in 1970 and is effective until the year 2023. Since the lease was signed, the ANG has upgraded many of the 1890-1905 era buildings (red brick) to modern-day standards while maintaining their historical architectural features. All temporary wooden buildings from the World War II era have been demolished with the exception of one. It has been upgraded and is currently in use as a carpenter shop for the ANG Civil Engineers. Some buildings under ARNG control have been improved, but most have not been maintained due to a lack of funds. ANG units assigned to Jefferson Barracks provide radar support to flying units, communications/electronics support, and civil engineering support to both active and reserve organizations. ARNG units provide combat engineers, military police, transportation and vehicle maintenance support. The size of the full-time work force, Air Force and Army technicians, active duty personnel, and state employees gives the station the appearance of an active duty base.

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SECTION 3.0 ENVIRONMENTAL SETTING

Jefferson Barracks ANGS is situated in eastern Missouri which includes the confluence of two of the nation's largest rivers – the Missouri and the Mississippi. The area lies within the Dissected Till Plains physiographic province. The Dissected Till Plains province is gently undulating, with altitudes ranging from 500 to 700 feet.

3.1 METEOROLOGY

The climate of Missouri is essentially continental. There are frequent changes in the weather, both from day to day and from season to season. Missouri is in the path of cold air moving down out of Canada, warm, moist air coming up from the Gulf of Mexico, and dry air from the west. While winters are cold and summers are hot, prolonged periods of very cold or very hot weather are unusual.

In the summer, temperatures in eastern Missouri rise to 90° F. or higher on an average of 55 to 60 days. In the winter, there is an average of about 70 days with temperatures below 32° F. The annual average temperature in the St. Louis area is 55.3° F.

The majority of precipitation occurs during the fall, winter, and early spring months. Measurable precipitation occurs on an average of about 100 days a year; about half of these will be days with thunderstorms. Precipitation in the St. Louis area averages approximately 38 inches a year. Snowfall is most common in December, January, and February, with a yearly average of approximately 17 inches. Major flooding occasionally occurs along the Missouri and Mississippi Rivers, normally during the March through July period. Tornadoes are also a danger in the area, mainly occurring during the months of March through June.

3.2 REGIONAL GEOLOGY

Three major structural features have been noted in the vicinity of Jefferson Barracks ANGS: the St. Louis Fault, Dupo Anticline, and the Cheltenham Syncline. The St. Louis Fault trends northeast, and rock layers dip 1 to 2 degrees toward the northeast. The Dupo Anticline trends northwest from Illinois into Missouri. The Cheltenham Syncline is located directly west of the Dupo Anticline. Rock formations that crop out consist primarily of limestone and cherty limestone, although several shale units are present. Exposed formations that range in age from Ordovician to Mississippian are distributed in St. Louis County, Missouri, as shown in Figure 3.1. The geology of the region is characterized by up to 150 feet of unconsolidated

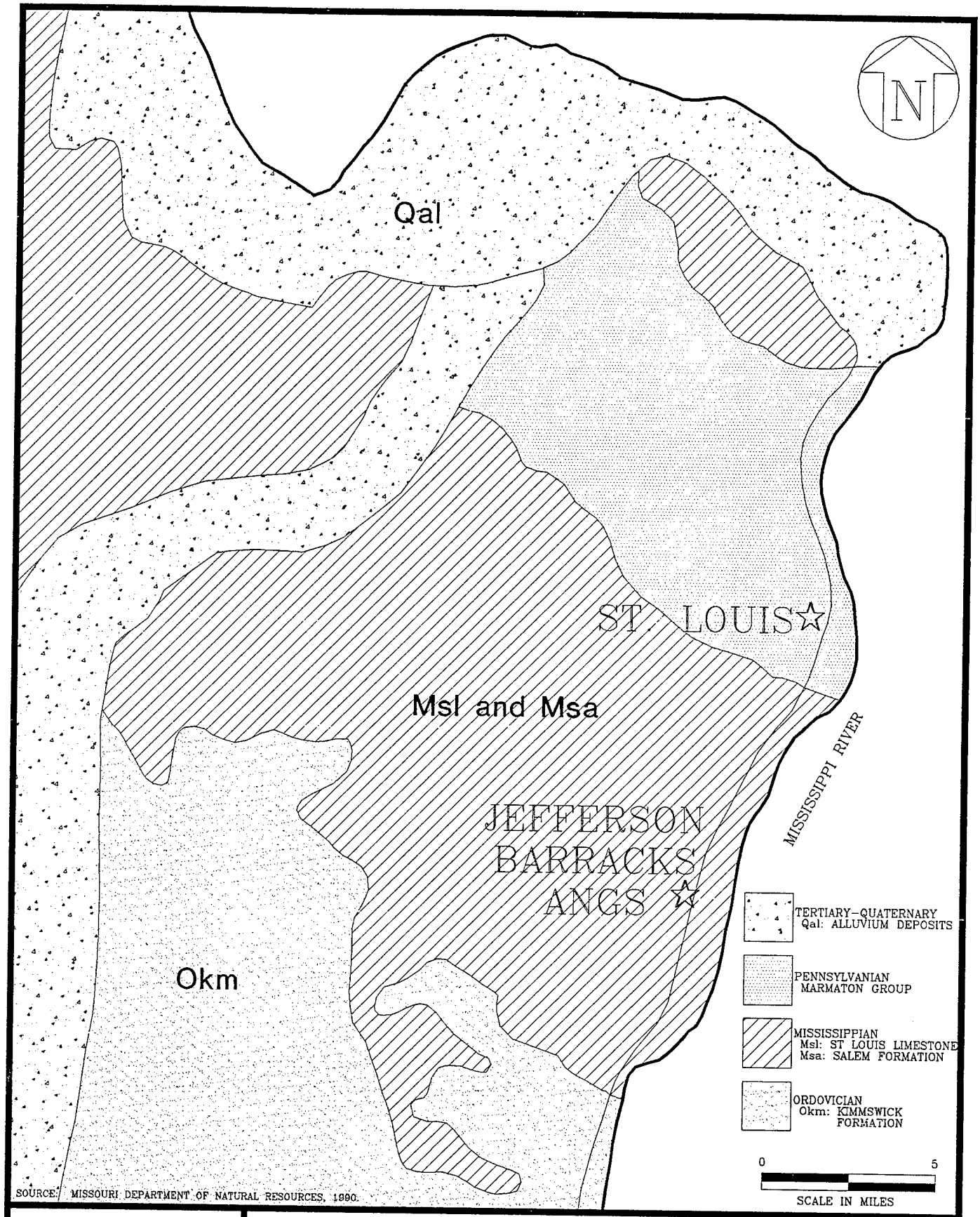

FIGURE 3.1

JEFF\GEO

GENERALIZED GEOLOGIC MAP
OF St. LOUIS COUNTY, MISSOURI
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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material, which is underlain by bedrock. The unconsolidated material includes lacustrine and glacial till deposits, which consist primarily of silt and clay. The St. Louis and Salem Formations are subject to the development of karst (sinkhole) topography.

Eastern Missouri lies near the western margin of the Illinois Basin; bedrock was deposited in the Illinois Basin during the Mississippian Period occurred 360 million years ago and lasted approximately 30 million years. The stratigraphic sequence preserved in the basin ranges from Cambrian to Upper Pennsylvanian in age. Regional bedrock is made up of the Meramecian Group, which consists of (in ascending order) the Warsaw, Salem, St. Louis, and St. Genevieve Formations. The St. Louis Formation is the uppermost bedrock unit at Jefferson Barracks. In east-central Missouri, the total maximum thickness of the Meramecian Group ranges from 300 to 450 feet. The lithology of the Meramecian Group consist primarily of shale, shaley limestone, dolostone, and limestone. The St. Louis and St. Genevieve Formations are primarily massive, fine-grained limestones containing occasional thin shale beds and chert. Shale and shalely limestone occur primarily in the lower half of the Group, in the Warsaw and Salem Formations. The Salem Formation is the most argillaceous (contains clay material) of the group and grades into a shalely limestone at its base. A generalized stratigraphic column of the area is depicted in Figure 3.2.

3.3 SOILS

The topography of St. Louis County varies widely in character, ranging from the flat, almost featureless floodplains of the Missouri and Mississippi Rivers, to the rugged, intensely dissected uplands of the west county area. Relief, percent of land surface in slope, and steepness of slope are common parameters applied to describe land features. Gently rolling includes areas with 2 to 5 percent slopes, rolling applies to those areas with 5 to 9 percent slopes, and steeply rolling or hilly denotes regions where the slopes are 10 percent or more with relief often greater than 150 feet (MDNR, 1986).

Soils at the station consist primarily of the Urban Land-Harvester complex, which are deep, moderately drained silt loams (see Figure 3.3). This complex consists of Urban Land and the intermingled areas of moderately well-drained Harvester soils on rolling and hilly uplands. Prior to urban development, these areas contained circular and elongated limestone sinks known as karst topography. Some sinks have been filled or altered during development and are no longer easily recognizable. The karst areas are about 50 to 55 percent located in Urban Land and Harvester soils, and are so intermingled or in such intricate patterns that to separate them in mapping is not practical. The Urban Land part of this complex is covered by streets, parking

System	Series	Group	Formation	Aquifer group	Thickness (feet)	Dominant lithology	Water-bearing character
Quaternary	Holocene		Alluvium		0–150	Sand, gravel, silt, and clay	Some wells yield more than 2,000 gpm.
	Pleistocene		Loess Glacial till	Post-Maquoketa	0–110 0–55	Silt Pebbly clay and silt	Essentially not water yielding.
Pennsylvanian	Missourian	Pleasanton	Undifferentiated		0–75	Shales, siltstones, "dirty" sandstones, coal beds and thin limestone beds	Generally yields very small quantities of water to wells. Yields range from 0–10 gpm.
	Desmoinesian	Marmaton	Undifferentiated		0–90		
		Cherokee	Undifferentiated		0–200		
	Atokan		Undifferentiated				
Mississippian	Meramecian		Ste. Genevieve Formation		0–160	Argillaceous to arenaceous limestone	Yield small to moderate quantities of water to wells. Yields range from 5 to 50 gpm.
			St. Louis Limestone		0–180		
			Salem Formation		0–180		
			Warsaw Formation		0–110		
	Osagean		Burlington–Keokuk Limestone		0–240	Cherty limestone	
			Fern Glen Formation		0–105	Red limestone and shale	
	Kinderhookian	Chouteau	Undifferentiated		0–122	Limestone, dolomitic limestone, shale and siltstone	
Devonian	Upper	Sulphur Springs	Bushberg Sandstone		0–60	Limestone and sandstone	
			Glen Park Limestone				
			Grassy Creek Shale		0–50	Fissile, carbonaceous shale	
Silurian			Undifferentiated		0–200	Cherty limestone	
Ordovician	Cincinnatian		Maquoketa Shale		0–163	Silty, calcareous or dolomitic shale	Probably constitutes a confining influence on water movement.
			Cape Limestone		0–5	Argillaceous limestone	Yields small to moderate quantities of water to wells. Yields range from 3 to 50 gpm. Decorah Formation probably acts as a confining bed locally.
	Champlainian		Kimmswick Formation	Kimmswick–Joachim	0–145	Massive limestone	
			Decorah Formation		0–50	Shale with interbedded limestone	
			Plattin Formation		0–240	Finely crystalline limestone	
			Rock Levee Formation		0–93	Dolomite and limestone, some shale	
			Joachim Dolomite		0–135	Primarily argillaceous dolomite	
			St. Peter Sandstone	St. Peter–Everton	0–160	Silty sandstone, cherty limestone grading upward into quartzose sandstone	Yields moderate quantities of water to wells. Yields range from 10–140 gpm.
			Everton Formation		0–130		
	Canadian		Powell Dolomite	Powell–Gasconade	0–150	Sandy and cherty dolomites and sandstone	Yields small to large quantities of water to wells. Yields range from 10 to 300 gpm. Upper part of aquifer group yields only small amounts of water to wells.
			Cotter Dolomite		0–320		
			Jefferson City Dolomite		0–225		
			Roubidoux Formation		0–177		
			Gasconade Dolomite Gunter Sandstone Member		0–280		
Cambrian	Upper		Eminence Dolomite	Eminence–Lamotte	0–172	Cherty dolomites, siltstones, sandstone, and shale	Yields moderate to large quantities of water to wells. Yields range from 10 to 400 gpm.
			Potosi Dolomite		0–325		
		Elvins	Derby–Doerun Dolomite		0–165		
			Davis Formation		0–150		
			Bonneterre Formation		245–385		
			Lamotte Sandstone		235+		
PreCambrian						Igneous and metamorphic rocks	Does not yield water to wells in this area.

MOST FAVORABLE AS WATER SOURCES

SOURCE: WATER RESOURCES OF THE ST. LOUIS AREA, MISSOURI, WATER RESOURCES REPORT 30, 1974.

FIGURE 3.2

JEFF\STRATCOL

GENERALIZED STRATIGRAPHIC COLUMN FOR ST. LOUIS COUNTY, MISSOURI

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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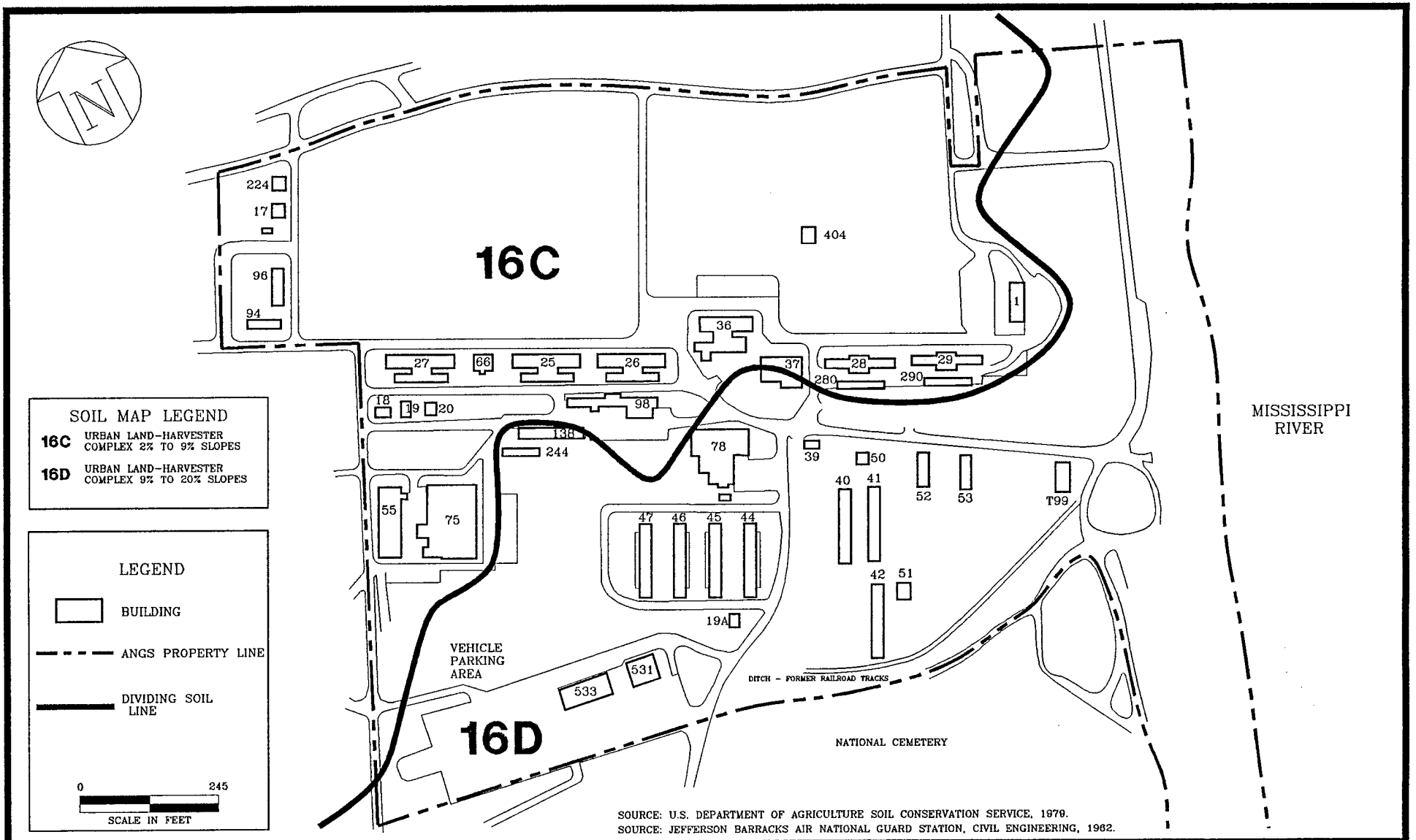

FIGURE 3.3

JEFF\JEFFBASE

SOIL SURVEY MAP

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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lots, buildings, and other structures that so obscure or alter the soil that identification of the series is not feasible (U. S. Department of Agriculture Soil Conservation Service, 1979). Typically, the surface layer of the Harvester soil is mixed very dark grayish brown and brown silt loam about 2 inches thick. The next layer, to a depth of about 20 inches, consists of brown and pale brown silt loam and silty clay loam fill material. Below the reworked fill material to a depth of about 60 inches is older, unworked, brown silt loam. In places, cuts and fills are several feet deep, and the cuts expose residual chert or limestone bedrock. In a few places, the surface layer is silty clay loam. In some areas, slopes around the sinks are more than 20 percent. The Urban land soil is essentially impervious to water. Permeability is moderately slow in the Harvester soils, natural fertility is medium, and organic matter content is very low. The surface layer of the harvester soils is friable. Surface runoff is rapid to very rapid.

The Harvester soils in this complex are in yards, open spaces around buildings, parks, and gardens and in undeveloped random tracts that are primarily in and around sinks. Most of the sinks in this unit are deep and have steep sides. They are generally not suitable for building sites because soils on the sides of the sinks are generally not stable; also, the sink can become plugged, resulting in a saturated soil condition in the bottom of the sink during some parts of the year.

3.4 SURFACE WATER HYDROLOGY

The City of St. Louis, near the confluence of the Missouri and Mississippi Rivers, has abundant access to surface-water supplies. According to the Missouri Department of Natural Resources, the City of St. Louis draws 100 percent of surface water from the Missouri River (MDNR, 1996). Flooding can occur in the area during all months, but is most common in March through July.

Federal Emergency Management Agency floodplain maps were reviewed to determine the extent of the 100-year floodplain in the vicinity of the station. The majority of Jefferson Barracks ANGS is not situated within the 100-year floodplain but is located in Zone C, or "areas of minimal flooding" (Figure 3.4). Only a small portion of the station, along the river bank, is impacted by the 100-year floodplain. A surface drainage map is provided in Figure 3.5. All natural drainage from the station is directly to the Mississippi River.

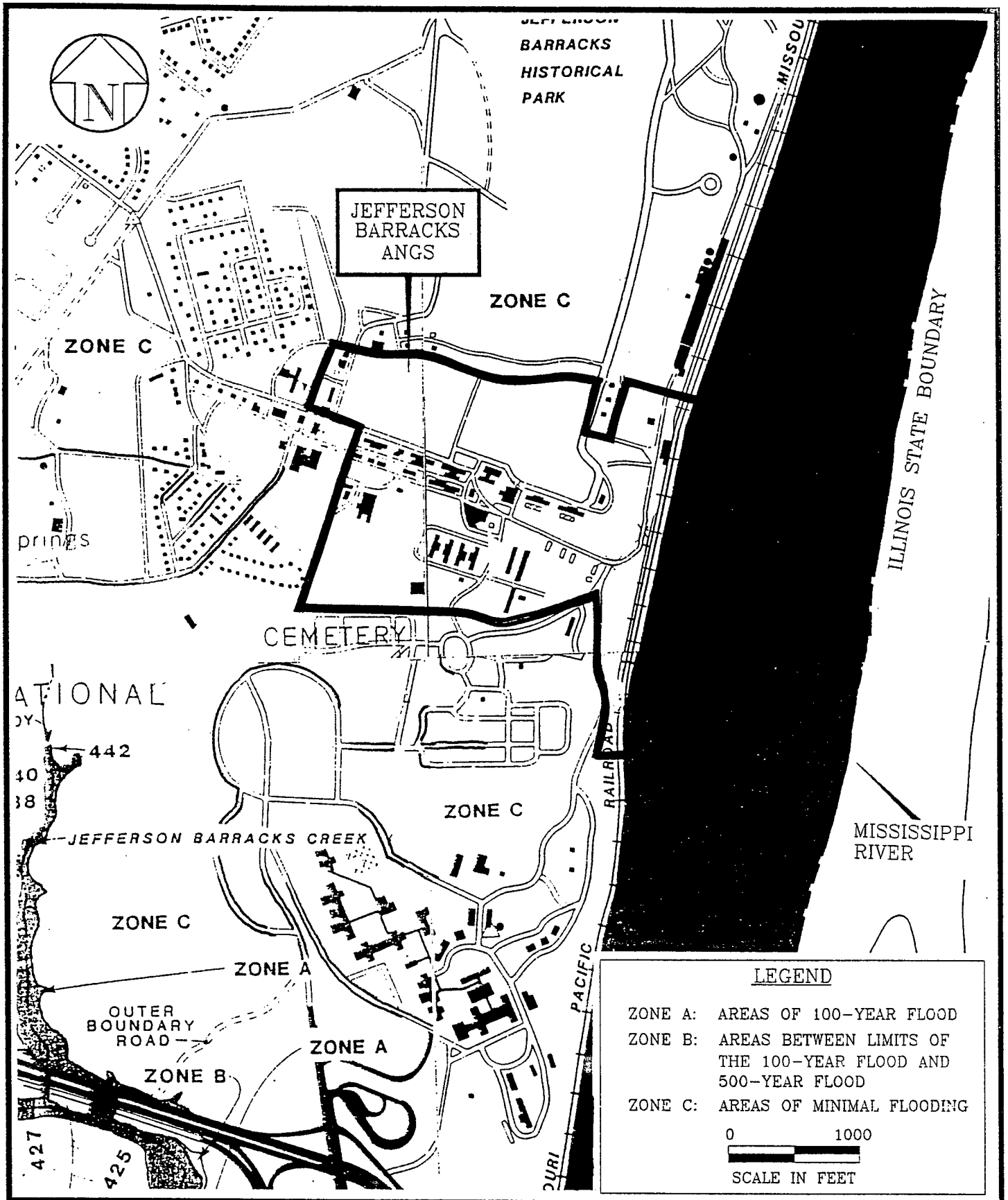

FIGURE 3.4

JEFF\FLOOD-PL

FLOODPLAIN MAP

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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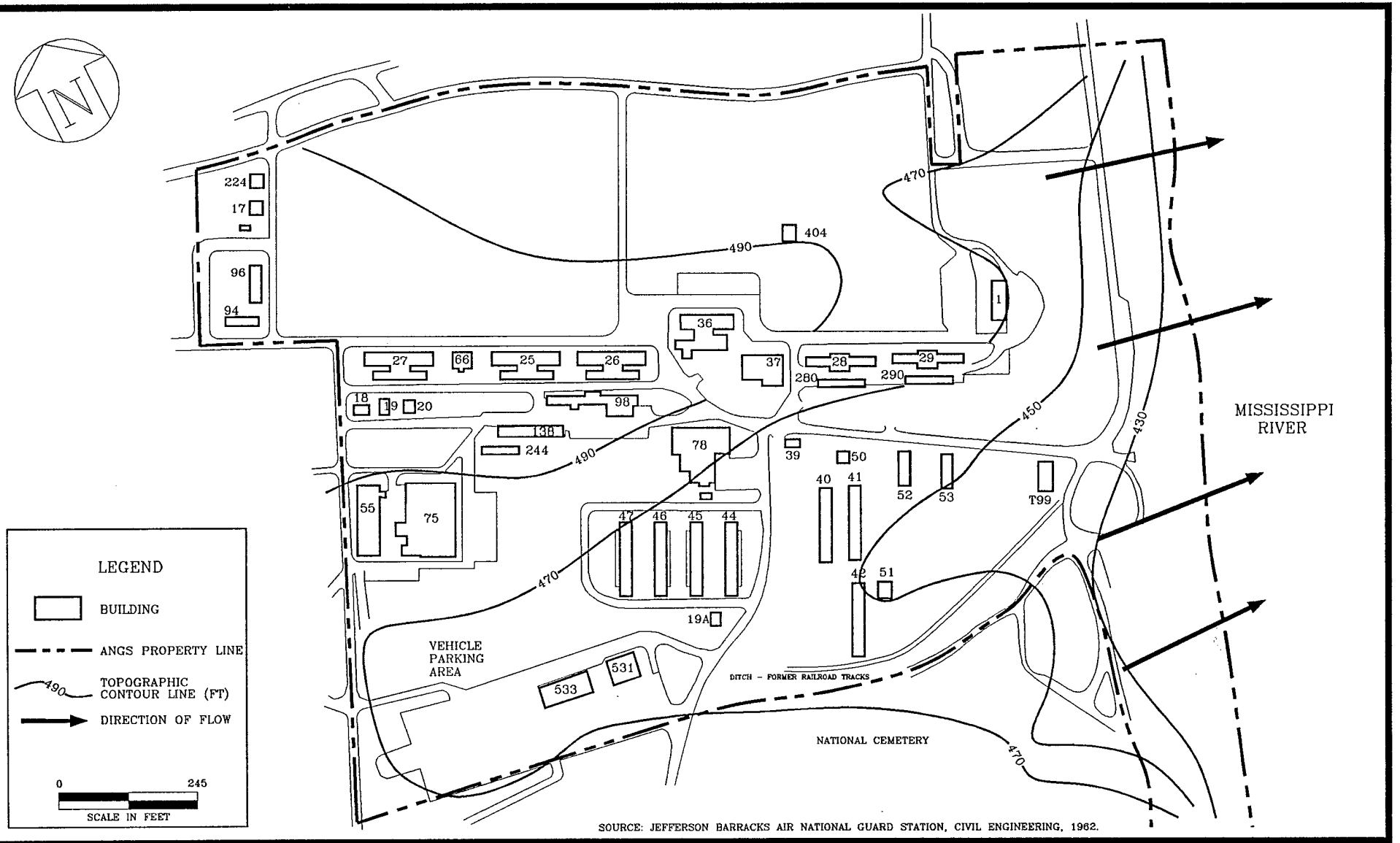

SOURCE: JEFFERSON BARRACKS AIR NATIONAL GUARD STATION, CIVIL ENGINEERING, 1962.

FIGURE 3.5

SURFACE DRAINAGE MAP

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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3.5 HYDROGEOLOGY

In addition to surface-water sources, a large amount of water is available from bedrock and alluvial aquifers that underlie the region. Though some groundwater is too mineralized to use, much is fresh and of good quality. Throughout much of St. Louis County, potable groundwater supplies are available from Mississippian limestones, but water yields are highly variable and unpredictable. However, these bedrock and alluvial aquifers account for only 1 and 2 percent of the total pumpage, respectively (U. S. Geological Survey and Missouri Geological Survey and Water Resources, 1974).

Large amounts of fresh water are stored in the bedrock and alluvium underlying the area. The bedrock aquifers are primarily dolomite and limestone with one notable exception, the St. Peter Sandstone. Groundwater occurs along fractures, bedding planes, and in solution openings in the limestone and dolomite and in voids between the grains in sandstone. The principal bedrock aquifers are the St. Peter, the Roubidoux, the Gasconade, and the Potosi. Shallow bedrock aquifers that are hydraulically connected with the rivers also receive recharge from natural infiltration of the rivers during sustained high-river stage and flooding. Most private water wells are only drilled deep enough to encounter the St. Louis Limestone, Salem Formation, or Warsaw Formation, minor aquifers (MDNR, 1996).

Areas having the greatest potential for development of groundwater are in the Mississippi and Missouri River floodplains. Water from the alluvial deposits generally is a very hard calcium-magnesium-bicarbonate type with iron and manganese content commonly being high. Saline water has moved upward from the underlying bedrock into the alluvial aquifers at Valley Park and Times Beach in the Meramec River valley and in the Mississippi River valley near St. Peters. Alluvial aquifers in the area are recharged by infiltration of stream water during sustained high-river stage and flooding, by direct precipitation, and by underflow from underlying and adjacent bedrock.

An undetermined amount of discharge from deeper aquifers into shallower aquifers is taking place in the St. Louis area. In areas such as Valley Park, where deep wells have been improperly cased or where casings have deteriorated, mineralized water from deeper aquifers has moved up into shallower horizons and, where head differences permit, some waters move from shallow aquifers into deeper ones through wells (U. S. Geological Survey and Missouri Geological Survey and Water Resources, 1974). The unconsolidated deposits in the vicinity of the station are not considered to be an aquifer due to the low water-bearing capacity of the deposits. Well yields from these deposits are described as "essentially not water yielding"

(PEER, 1993). Logs of wells drilled in the general area show total depth completions from approximately 200 feet to approximately 325 feet, with yields of from .5 to 4 gallons per minute.

A zone of karst terrain occurs in a discontinuous belt surrounding the Station on the northeast, west, and southwest. Karst terrain is characterized by the development of caves and sinkholes, and groundwater flow in karst terrain occurs principally in solution-enlarged joints and fractures. Consequently, the direction of groundwater flow in bedrock in the vicinity of the station is difficult to ascertain. Due to the lack of resulting geologic data from any geotechnical or Remedial Investigation activities conducted at Jefferson Barracks ANGS in the past several years, it was not possible to accurately estimate site-specific groundwater conditions. Although no groundwater was encountered during excavations for removal of USTs at the SS-1 site west of Building 40, groundwater was encountered in several of the borings drilled during this PA/SI and is discussed further in Section 6.0. Local groundwater flow direction is generally toward the Mississippi River. According to the MDNR, there are no active public water supply wells within a 4-mile radius of the Jefferson Barracks ANGS.

3.6 CRITICAL HABITATS/ENDANGERED OR THREATENED SPECIES

According to the United States Department of the Interior, Fish and Wildlife Service field office in Columbia, Missouri, no Federally listed or proposed threatened or endangered species or designated or proposed critical habitat occurs within the immediate area of Jefferson Barracks ANGS, nor does any wetland habitat occur within the immediate area. However, wetland habitat may occur along the Meramec and Mississippi Rivers, which occur within a 4-mile radius of the Station.

The following is a list of Federally listed threatened, endangered, and candidate species potentially occurring within a 4-mile radius of Jefferson Barracks ANGS:

Lampsilis abrupta (a mussel): Its main concentration is in the lower 55 miles of the Meramec River.

Macrhybopsis gelida (a fish): Occurring in the Missouri and Mississippi Rivers, it inhabits main channels of large, turbid rivers with sand or fine gravel bottoms and strong current.

Scaphirhynchus albus (a fish): Occurring in the Missouri and Mississippi Rivers, it inhabits large, turbid rivers with swift current and firm sand or gravel bottom.

Haliaeetus leucocephalus (bald eagle): During winter they concentrate near rivers with open water and in areas with large numbers of waterfowl.

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SECTION 4.0 SITE EVALUATION

4.1 ACTIVITY REVIEW

4.1.1 Preliminary Assessment Interviews

During the PA at Jefferson Barracks ANGS, interviews were conducted with ten station personnel who were knowledgeable of both current and past waste disposal practices. Follow-up telephone interviews were also conducted with 30 retirees and personnel who were previously assigned to Jefferson Barracks ANGS, but who are presently assigned to other military installations. Current primary station operations that generate hazardous wastes are vehicle and radar maintenance; therefore, interview topics were focused primarily in these areas.

The interview process revealed that the following locations at the station, shown on Figure 4.1, are of concern because of historical use of HM/HW:

- **A Disposal Area East of Building 42 (AOC-A):** Waste oil generated by vehicle maintenance activities at Building 51 was disposed into a pipe protruding from a concrete pad east of Building 42 during the 1960s and 1970s. (There was no evidence of either the pipe or the concrete pad at the time of the PA visit; however, an undated photograph, estimated to have been taken during the late 1960s or early 1970s, confirmed the presence of a concrete pad near the southeast corner of Building 42.) Prior to World War II, Building 42 was used as quarters for noncommissioned officers; however, in 1952 the building was converted to administrative offices, and later an indoor firing range was included. Building 51, constructed in the late 1960s, was used for vehicle maintenance on a full-time basis until 1975. Building 51 had two maintenance bays where a combined total of two to four vehicles were serviced weekly. Waste oil generated during oil changes ranged from one to ten gallons per vehicle. Consequently, based on the number of vehicles serviced and their oil capacities, disposal of waste oil was 4 to 20 gallons per week for a period of seven years, resulting in a maximum potential of 7,280 gallons of disposed waste oil generated by the facility.

- **A Storage Area South of Building 51 (AOC-B):** Based on accounts from several persons who are familiar with the maintenance activities at Building 51,

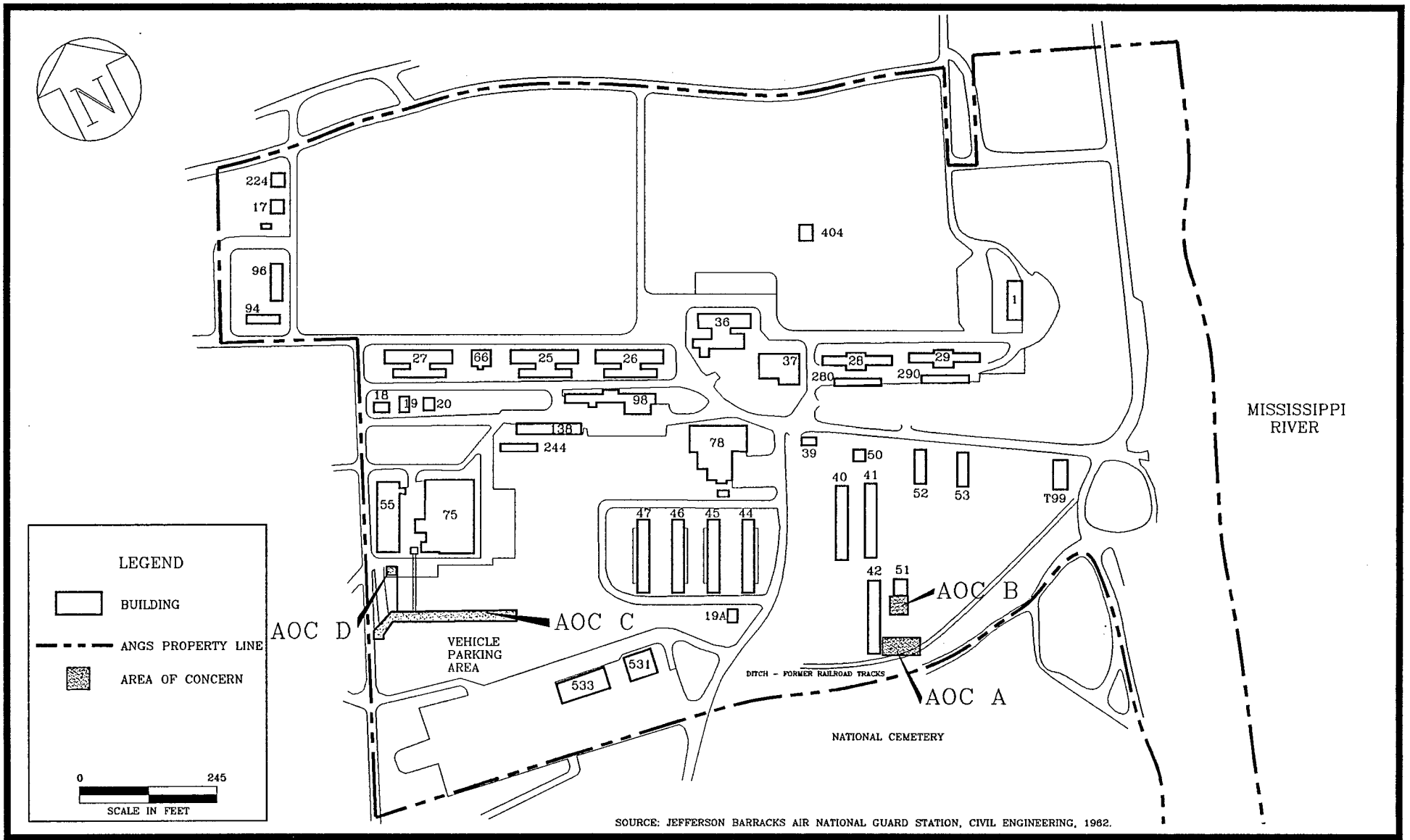

FIGURE 4.1

JEFF\JEFFBASE

AOC LOCATIONS MAP

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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it was determined that a 3,000-gallon aboveground storage tank (AST) was used to store waste motor oil in an area on the southeast side of Building 51. The tank replaced 55-gallon drums that had previously been used for storage of the waste oil.. It is estimated that the tank was present from the early 1970s until the late 1980s and was used to store waste motor oil for all ARNG maintenance facilities. Other materials such as hydraulic fluid, new motor oil, and cleaning compounds were stored in 55-gallon drums on a gravel area next to Building 51. The gravel was periodically replaced because of staining from spilled materials. No records documenting the disposition of the replaced gravel were found.

- **A Drainage Ditch South of Building 75 (AOC-C):** The area is located approximately 150 feet south and at a lower elevation from a concrete ramp located southwest of Building 75. Building 75 was used from the 1960s until 1990 to inspect and perform maintenance, including oil changes on ARNG vehicles. Vehicles were steam-cleaned prior to inspections and/or maintenance being performed. The effluent, including oils, greases, fuels, and solvents, drained into an 8-inch polyvinyl chloride (PVC) pipe that emptied into the unlined drainage ditch. This area also received runoff from an unpaved vehicle parking area south of the ditch.

- **A Hole Southeast of Building 75 (AOC-D):** Waste oil generated during oil changes at a concrete ramp, located southwest of Building 75, was disposed in a shallow hole. The ramp was used for oil changes from the 1960s until the late 1970s. The ramp was used heavily during and prior to summer deployments. Waste oil disposed ranged from one to ten gallons per week for ten years. A visit to the site confirmed the existence of a filled-in hole in a gravel area.

4.1.2 Preliminary Assessment Records Search

As part of the PA at Jefferson Barracks ANGS, station records were reviewed. These records provided more detailed or corroborating information about the station in general, and about some of the potential areas of concern. Key records reviewed included:

- Jefferson Barracks County Park Museum archives (i.e., files, old photographs, etc.);

- Jefferson City ARNG Facility Engineer's files that included as-built drawings of facilities at Jefferson Barracks;

- Jefferson Barracks ANGS Plans, including a Station Plan, Water/Sewer/Storm Drainage Systems Plan, and Electrical/Gas Systems Plan;

- Pertinent information on hazardous materials use and hazardous wastes generation and disposal at the station;

- Available geologic, hydrologic, meteorologic, and environmental data from pertinent Federal, state, and local agencies; and

- Previous investigations at the station, including surface and subsurface soil sampling, investigation data, and conclusions.

4.1.3 Hazardous Materials Inventory

AOCs were selected on the criteria that reasonable evidence of improper use, handling, or potential spillage must exist. The interviews and records search revealed that the greatest potential for a release of a HM/HW occurred from vehicle maintenance activities between 1941 and 1946 and from 1952 to the present. Methods of storage and disposal of hazardous materials and wastes generated at the station were identified and are presented in Table 4.1. Vehicle maintenance, the major operation of the station, generated waste oils, cleaning compounds, and other wastes and materials as indicated in Table 4.1. Very small amounts of hazardous wastes were generated by radar maintenance activities, also listed in the table. Although not all buildings listed on the table were considered to be areas of concern, activities at several of the buildings resulted in their consideration as AOCs. The buildings associated with the four AOCs identified during the PA have been flagged in the table.

No pesticide storage areas or radioactive material storage areas were identified by the PA.

4.2 DISPOSAL/SPILL AREA OF CONCERN IDENTIFICATION

Interviews with station personnel and a station tour resulted in the identification of four areas potentially contaminated with hazardous materials or hazardous wastes. These four areas are characterized in detail below, and their locations are depicted in Figure 4.1.

Table 4.1
Inventory of Hazardous Materials
157th ACG, Jefferson Barracks ANGB, St. Louis, Missouri

Shop	Possible Waste Materials	Quantities Disposed	Methods of Treatment, Storage, and Disposal in Chronological Order				
			1950s	1960s	1970s	1980s	Present
Radar Bldg. 40 (not associated with an AOC)	Isopropyl Alcohol	1 gal/yr	UNK	UIP	UIP	UIP	UIP
	Paint Thinner	2 gal/yr	UNK	UIP/DMP	UIP/DMP	UIP/DMP	UIP/DMP
	Lacquer Thinner	5 gal/yr	UNK	UIP/DMP	UIP/DMP	UIP/DMP	UIP/DMP
ARNG Facility Maintenance Bldg. 75 (associated with AOC-C and AOC-D)	**Waste Solvents:**						
	Alcohol	2 gal/yr	DMP	DMP	DMP	DMP	DRMO
	Lacquer Thinner	5 gal/yr	DMP	DMP	DMP	DMP	DRMO
	Enamel Thinner	5 gal/yr	DMP	DMP	DMP	DMP	DRMO
	Waste Oil	2 gal/yr	SUMP	SUMP	SUMP	SUMP	DRMO
ARNG Vehicle Maintenance Bldg. 55 (associated with AOC-C and AOC-D)	Batteries	25 batt/yr	N/A	N/A	DRMO	DRMO	RCY
	Antifreeze	100 gal/yr	N/A	N/A	SEW	SEW	DRMO
	Part Cleaners (PD 140)	50 gal/yr	N/A	N/A	DRMO	DRMO	DRMO
	Waste Paints/Thinners	15 gal/yr	N/A	N/A	DMP	DMP	DRMO
	Fuels (gasoline, diesel)	100 gal/yr	N/A	N/A	RCY	RCY	RCY
AGE Bldg. 50 (not associated with an AOC)	Antifreeze	20 gal/yr	UNK	SEW	SEW	SEW	SEW
	Enamel thinner	4 gal/yr	UNK	DMP	DMP	LAM	DRMO
	Turbine Oil	24 gal/yr	UNK	SUMP	SUMP	LAM	DRMO
	Gasoline	10 gal/yr	UNK	RCY	RCY	RCY	RCY
	Spill Cleanup – Absorbent	50 lbs/yr	UNK	DMP	DMP	DMP	DRMO
Vehicle Maintenance Bldg. 41 (not associated with an AOC)	Antifreeze	100 gal/yr	UNK	SEW	SEW	SEW	SEW
	Diesel	100 gal/yr	UNK	RCY	RCY	RCY	RCY
	Gasoline	50 gal/yr	UNK	RCY	RCY	RCY	RCY

Table 4.1 (Concluded)
Inventory of Hazardous Materials
157th ACG, Jefferson Barracks ANGB, St. Louis, Missouri

Shop	Possible Waste Materials	Quantities Disposed	Methods of Treatment, Storage, and Disposal in Chronological Order				
			1950s	1960s	1970s	1980s	Present
Vehicle Maintenance Bldg. 41 (Concluded) (not associated with an AOC)	Batteries (Lead Acid)	50 batt/yr	UNK	LAM	LAM	LAM	RCY
	Waste Paint	5 gal/yr	UNK	DMP	DMP	DMP	DRMO
	Part Cleaners (PD 140 Solvents)	50 gal/yr	UNK	DMP	DMP	DMP	DRMO
Vehicle Maintenance Bldg. 51 (associated with AOC-A and AOC-B)	Hydraulic Fluid	UNK	UNK	UNK	UNK	NA	NA
	Part Cleaners	UNK	UNK	UNK	UNK	NA	NA

SEW – Sanitary sewer or neutralizing pit.
gal – gallons.
UIP – Used in Process.
batt – batteries.
DRMO – Directed to the Defense Reutilization and Marketing Office.
lbs – pounds.
Bldg. – Building.
UNK – Unknown.
SUMP – Waste oil sump.
DMP – Disposed of in a general refuse dumpster.
RCY – Recycled.
LAM – Sent to Lambert ANGB for disposal.
AGE – Aerospace Ground Equipment.

4.2.1 Disposal Area AOC (AOC-A) – Background and Operational History

AOC-A is located immediately east of the southeast corner of Building 42. It is adjacent to a ditch where railroad tracks were previously located.

Building 51, constructed in the late 1960s, lies adjacent to, and east of, Building 42. Building 51 was used by the ARNG Organizational Maintenance Shop Number Ten (OMS #10) for vehicle maintenance on a full-time basis until 1975. Building 51 had two maintenance bays where two to four vehicles were serviced weekly. During this period, ARNG personnel would empty drain pans of used motor oil into a pipe east of Building 42. The pipe was embedded in a concrete slab and was flush with the surface of the slab. The pipe and the concrete pad are no longer present. It should be noted that some of the vehicles worked on at this building had an engine oil capacity ranging from one to ten gallons. Thus, based on the number of vehicles serviced and their oil capacities, from 4 to 20 gallons of waste oil were disposed each week for a period of seven years, resulting in a maximum potential of 7,280 gallons of disposed waste oil.

Building 51 was under the control of the ARNG OMS #10 from 1968 until 1991, when the ANG took control of the building. The estimated period for usage of the waste oil disposal area is 1968 until 1975.

4.2.2 Storage Area AOC (AOC-B) – Background and Operational History

AOC-B is located immediately south of Building 51, used by the ARNG for vehicle maintenance on a full-time basis until 1975. The AOC consisted of a gravel area where 55-gallon drums of HM/HW were stored and an aboveground waste oil storage tank was located. The storage tank was removed in the late 1980s. A 15-foot-by-18-foot concrete pad was constructed adjacent to Building 51 in 1991. The rest of the area is covered with gravel and grass and is presently used to store Civil Engineering Roads and Grounds equipment.

AOC-B was used for storage of waste oils (hydraulic and automotive), stoddard solvent, 1,1,1-trichloroethane, carbon tetrachloride, and cleaning chemicals for all ARNG vehicle maintenance facilities. A 3,000-gallon AST for used motor oil was in use from 1970 until the late 1980s. Prior to 1970, waste oil was stored in 55-gallon drums placed directly on the ground or on metal storage racks. Waste oil disposed amounted to 3,000 gallons per year. The hazardous waste manager for this area (1975 to 1991) confirmed spillage and stated the gravel had to be replaced every few years because of oil contamination. Spillage was in excess of 100

gallons per year of waste oil and one gallon per year of solvents, resulting in an estimated total maximum spillage of 2,000 gallons of waste oil and 20 gallons of solvents.

4.2.3 Drainage Ditch AOC (AOC-C) – Background and Operational History

AOC-C is located approximately 150 feet south of Building 75 at the bottom of the hill immediately north of a military vehicle parking area. Building 75 was used from the 1960s until 1990 to inspect and perform maintenance, including oil changes, on ARNG vehicles. Vehicles were steam-cleaned at the ramp prior to inspections and/or maintenance being performed. Effluent from the ramp, including oils, greases, fuels, and solvents, drained into an 8-inch PVC pipe that emptied into a dirt drainage ditch. AOC-C also received runoff from an unpaved vehicle parking area south of the ditch.

4.2.4 Waste Oil Dump AOC (AOC-D) – Background and Operational History

AOC-D is located approximately 100 feet southwest of Building 75 and approximately 40 feet south of Building 55. Waste oil generated during oil changes in Building 75, and at a concrete ramp located southwest of Building 75, was disposed in a shallow hole in the ground surface. The ramp was used for oil changes from the 1960s until the late 1970s. The ramp was used heavily during and prior to summer deployments. Waste oil disposed ranged from 1 to 20 gallons per week for ten years. A visit to the site confirmed the existence of a filled-in hole in a gravel area.

4.3 OTHER PERTINENT FINDINGS

Other pertinent information identified during the PA include:

- **Radar maintenance activities:** Maintenance activities have been conducted since the early 1950s in Building 40 and the radar site located adjacent to Building 404, which is in the north sector of the station in what is known as the parade grounds. Most maintenance activities have been related to electronic repair or minor corrosion control. Maintenance on vehicles belonging to the 131st TCS are conducted in the ANG consolidated vehicle maintenance facility, Building 41. Generation of hazardous waste has been very minimal, mostly some waste insulating oils, paints, and solvents. Small quantities of hazardous wastes (less than one gallon) have been stored in Building 40 and disposed of through the Defense Reutilization and Marketing Office (DRMO) at Lambert Field. The

DRMO is the Federal Agency responsible for correctly disposing of small quantities of hazardous waste. There are no documented instances of any releases to the environment as a result of these activities.

- **Navy activities:** The Naval Reserve unit has some assigned vehicles that they maintain. Maintenance is restricted to minor tasks such as oil changes and tune-ups that are normally performed during unit training assembly weekends and annual training. There are no documented instances of any releases to the environment as a result of these activities.

- **Air National Guard Consolidated Vehicle Maintenance Facility (Building 41) and related activities:** Most ANG vehicle maintenance activities have been restricted to Building 41 (Figure 4.1). The area in front of Building 41 is paved, and the floor drains are connected to an oil water separator (OWS), which is tied into the storm drain system. During 1993, a project to replace the OWS and connecting pipe was completed. The soil was tested and found to be clean of any contamination. HM/HW are stored on a concrete pad behind Building 40. Disposal of hazardous waste is through Lambert Field. There was no visible evidence of contamination in this area and no records of any spills.

  In 1992, an ANG vehicle refueling facility located west of Building 40 was shut down and the USTs removed. All contaminated soil that exceeded Missouri standards was removed and disposed at Northside Landfill in Washington, Missouri, a permitted facility, and clean closure of the site was achieved. A new refueling facility was constructed. All ANG vehicles are washed and parked on paved areas that have OWS that are connected to the storm drain system. There was no documentation or physical evidence of environmental releases in any maintenance, vehicle refueling or vehicle parking areas to support any additional investigation.

- **Vehicle washrack next to Building 533:** A washrack constructed in 1970 by the ARNG during annual training was used until 1990 (Figure 4.1). The drainage system never functioned properly because of poor design, resulting in fuel, oil, and greases being spilled on the adjacent soil. The washrack drain consisted of a 4-foot-by-4-foot-by-1.5-foot deep concrete vault with a metal grate located at the west end of the washrack concrete pad. There is an outlet pipe located 6 inches above the bottom of the vault. It is now connected to the sanitary sewer,

but was initially connected to the storm drain. The pipe was connected to the sanitary sewer during the 1980s.

The washrack next to Building 533 was not considered an AOC and is not eligible for investigation under the IRP because it remained in operation until 1990, and the source of potential contamination was active after the January 1984 cut-off date. This area will be considered for investigation under a separate environmental program.

- **Other activities:** Coal and fuel oil were stored along a former railroad siding area on the southeast corner of the station. Old photos, undated, confirmed open storage of coal directly on the ground and the parking of railroad tank cars in this area. Additionally, Building 56, a wooden building erected in 1905, was used to store coal until the middle 1930s and was also investigated. The building was demolished in 1962. The building was located on what is now a paved parking area immediately south of Building 290 (Figure 4.1). However, there was no evidence of environmental contamination to support further investigation of these two areas so no soil samples were collected.

SECTION 5.0 FIELD PROGRAM AND FINDINGS

The purpose of the SI was to confirm the presence or absence of contamination at the four AOCs identified in the PA at Jefferson Barracks ANGS, and to provide data to reach a decision at each AOC. This section describes the field activities performed during the SI to accomplish these objectives, the methodologies used to conduct these activities, and the results of the inspection program. The SI at Jefferson Barracks ANGS commenced on 5 December 1994 and was completed on 15 December 1994.

5.1 GENERAL APPROACH

The suspected mode of contamination at the four AOCs described in Subsection 4.2 is by spillage or intentional application to the ground surface of wastes, or disposal of wastes into a pipe leading underground. Therefore, geophysical surveys, field screening using soil gas surveys, and soil borings to obtain soil samples for confirmation analyses were the inspection methods best used to meet project goals and objectives. A piezometer network was planned but not completed when groundwater was not encountered at all drilled locations above the local bedrock. Surface water samples were to be collected for laboratory analysis from the ditch at AOC-C if water was present. However, during the duration of field work, the ditch remained dry, and no surface water samples could be submitted for analysis.

Information obtained from the station indicated the depth to bedrock at the AOCs varied from 10 feet to 40 feet below land surface (BLS). It was known that, during excavations for removal of USTs at the SS-1 site west of Building 40, no bedrock or groundwater was encountered at a depth of 23 feet. Therefore, soil borings were planned to be drilled to the bedrock or the water table at each AOC. Soil samples were collected at 5-foot intervals for field screening and geologic classification, and soil samples were collected and submitted for laboratory analysis from each boring.

5.2 FIELD SCREENING ACTIVITIES

5.2.1 Geophysical Surveys

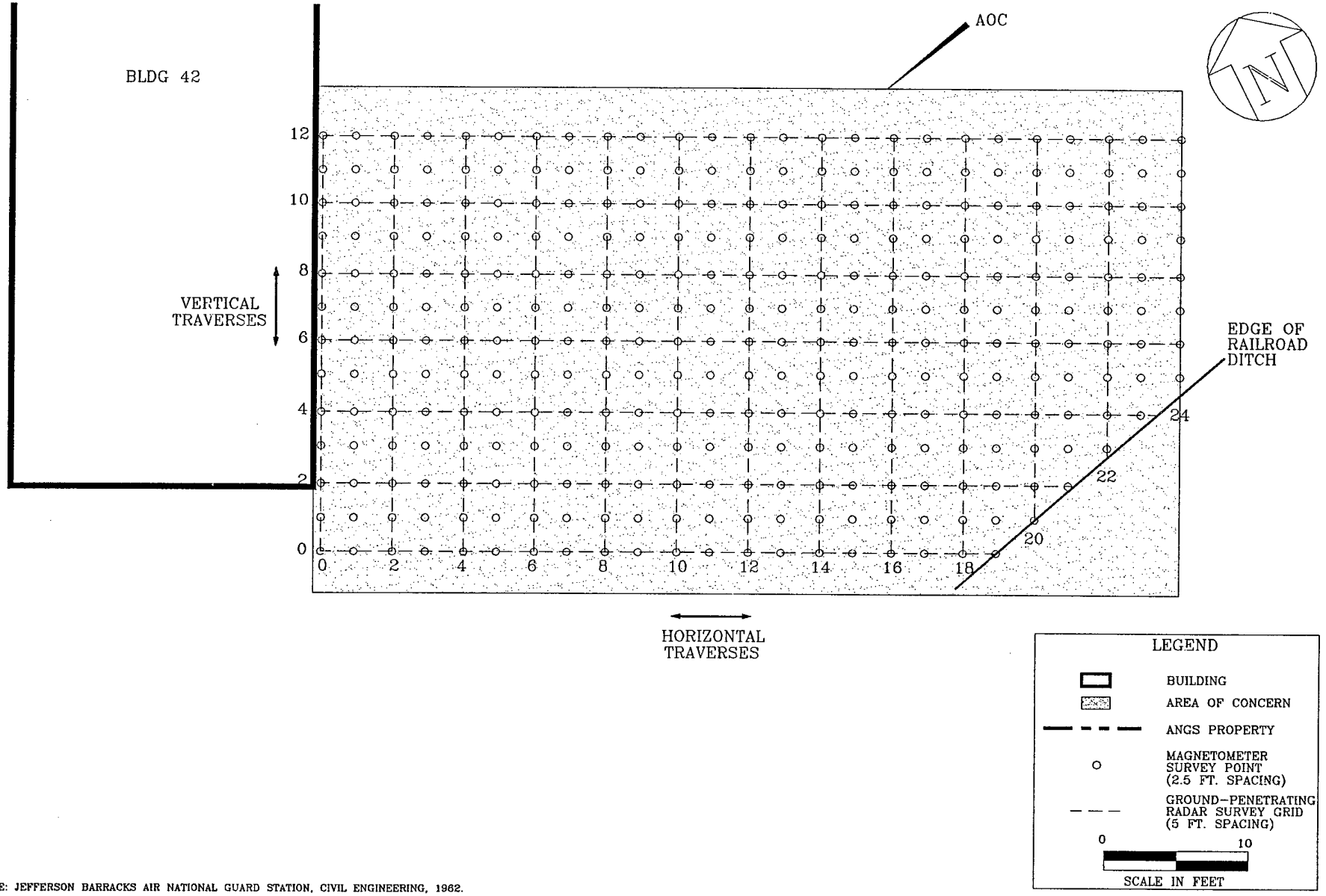
A geophysical survey of both AOC-A and AOC-D was performed prior to the soil vapor survey or the installation of soil borings. At AOC-A, the purpose of the survey was to investigate reports of a pipe into which waste oil from vehicle maintenance activities was poured. At AOC-D, the purpose of the survey was to investigate reports of a possible underground sump

or tank into which waste oil was poured. Two geophysical investigation techniques (ground-penetrating radar (GPR) and magnetometer) were used to detect the presence and location of subsurface metallic or non-metallic structures or anomalies, such as underground tanks or buried pipes, that may indicate a possible source of contamination and may interfere with the soil vapor survey and soil boring activities at these two AOCs.

Ground-penetrating radar is a geophysical survey technique that provides a continuous real-time cross-section of shallow subsurface conditions. The technique is suitable for locating buried non-metallic or metallic structures. The GPR transmits a radar impulse downward into the ground. A portion of this signal is reflected at subsurface interfaces where electrical properties change significantly. The reflected radar signal is recorded as depth-dependent impulses on a scanning, time-based graphic chart recorder. Thus, towing the radar antenna along a traverse on the ground results in a cross-section depicting the longitudinal distribution of subsurface strata and other features over which the radar antenna has passed. The GPR survey was conducted using a Geophysical Survey Systems, Inc. Subsurface Interface Radar™ (SIR) System 3 and a 300 megahertz (MHz) radar antenna. Complete GPR survey results are provided in Appendix A.

The GPR survey at AOC-A was conducted over a 60-foot-by-30-foot orthogonal grid with a spacing of 5 feet (see Figure 5.1), while at AOC-D, the GPR survey was conducted over a 30-foot-by-30-foot orthogonal grid, also with a spacing of 5 feet (see Figure 5.2). Several additional intermediate traverses were added to the GPR survey at AOC-D after the base survey was performed. At both AOCs, the radar was pulled along each of the horizontal and vertical traverses comprising the orthogonal grid. The GPR was operated with a 300 MHz radar antenna. Using a two-way slowness value of 8 nanoseconds (ns) per foot (for silt loam), a range of 168 ns was chosen. Using a pulse width of 3 ns for the 300 MHz antenna, the cycles per scan was calculated to be 56. The high pass filter was then set at 20 cycles/scan and the low pass filter at 100 cycles/scan. With these settings, the resultant GPR trace indicated a penetration depth of approximately 10 feet was achieved at both AOCs.

A dual-sensor magnetometer, referred to as a gradiometer, is a device that can locate buried ferrous metal objects. The magnetometer measures the intensity of the earth's magnetic field at the surface, and subsurface ferrous metal objects cause a detectable distortion of this magnetic field. Two sensors, spatially separated vertically by approximately 2.5 feet, are used to take two magnetic field readings at one location. Comparison of the two readings allows a gradient value of the magnetic field to be calculated, thus removing regional magnetic effects and diurnal variance of the field. The gradient results obtained over a regular grid and analyzed together



SOURCE: JEFFERSON BARRACKS AIR NATIONAL GUARD STATION, CIVIL ENGINEERING, 1962.

FIGURE 5.1

JEFF/EAOC-2

DISPOSAL AREA AOC (AOC A) GEOPHYSICAL SURVEY

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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JULY 1996

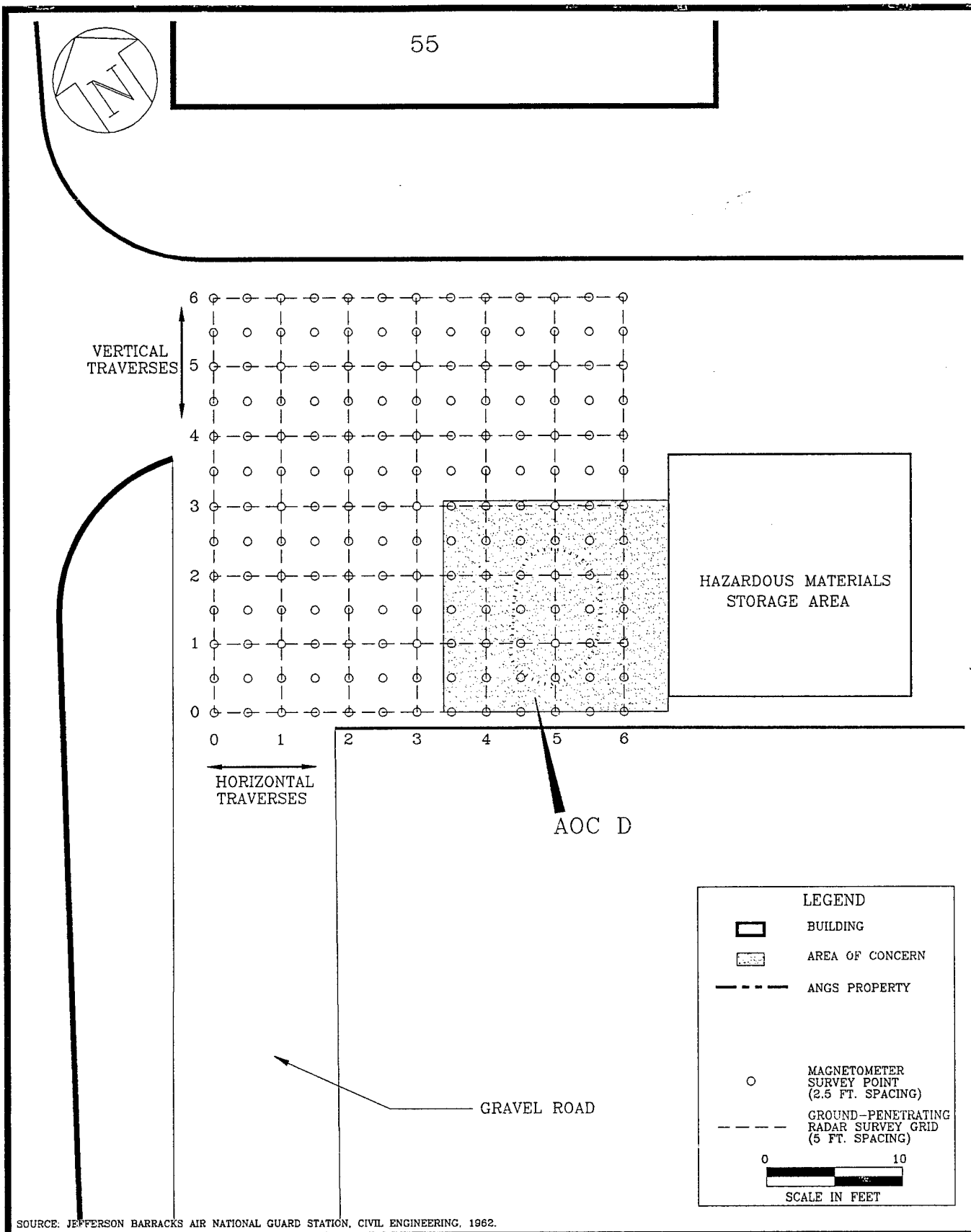

FIGURE 5.2

JEFF\D-AOC-2

WASTE OIL DUMP AOC
(AOC D) GEOPHYSICAL SURVEY
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

OPTECH
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JULY 1998

can define the location of buried ferrous metal anomalies. The magnetometer survey was conducted using a Geometrics 856-AG magnetometer with gradiometer option. Complete magnetometer survey results are provided in Appendix A.

The magnetometer employed was a dual-sensor unit operated as a gradiometer. This mode of operation provides the best resolution for total magnetic field anomalies and is therefore most appropriate in searching for shallow subsurface ferrous metal objects. The survey involved the recording of gradient magnetometer readings at each intersection point of the grid laid out at AOCs A and D (see Figures 5.1 and 5.2, respectively). The grid spacing in both directions was 2.5 feet, and the total size of the orthogonal grid was 60-feet-by-30 feet for AOC-A and 30-feet-by-30 feet for AOC-D. Operators performing the magnetometer survey removed all ferrous metal objects from their bodies. Magnetic field readings obtained were generally on the order of 54,700 gauss. Sufficient signal strengths were obtained over the entire grid area.

5.2.2 Soil Screening

5.2.2.1 Soil Gas Surveys

Prior to installation of soil borings, a soil gas survey was conducted by DHL Analytical of Austin, Texas, at the four AOCs at the station. The purpose of the soil gas survey was to delineate the extent of any benzene, toluene, ethylbenzene, and total xylenes (BTEX) or total petroleum hydrocarbons (TPH) contamination detected at the AOCs. BTEX analysis was performed using United States Environmental Protection Agency (USEPA) Method 8020 Modified, and TPH analysis was performed using Method 8015 Modified. TPH analysis included total volatile hydrocarbons in the range of C1 through C9 and indicated concentrations expressed as hexane. The results were used for developing the optimum location of soil borings needed to confirm and to attempt to delineate soil contamination.

The soil gas survey was accomplished using a probe, consisting of 3/4-inch hardened steel pipe with threaded tips and 1/8-inch nyaflow tubing that was driven into the ground to a depth of 18 inches BLS using a hand-held electric hammer. A 3-foot drill bit with a tungsten carbide tip was used to drill through concrete or hard gravel fill. After the probe was situated at its prescribed depth, a decontaminated 20 cubic centimeter (cc) volume glass syringe was used to evacuate the air within the tubing. The 20-cc glass syringe was then purged twice with soil gas prior to collecting the sample. After flushing the syringe twice at each sampling location, the third 20-cc volume soil gas sample was analyzed immediately on-site for TPH and BTEX in a mobile laboratory. A field duplicate was collected for every 10 samples to provide a quality assurance

check on analytical procedures and results. Duplicate samples were collected by withdrawing two volumes of soil gas from a specific sampling location. Ambient air blanks, internal standards, and surrogate recoveries were some of the various quality assurance/quality control (QA/QC) procedures applied to insure proper decontamination and equipment performance. AOC-specific soil gas survey results are discussed for each AOC in Section 6.0, and complete soil gas survey results are included in Appendix B.

5.2.2.2 Photoionization Detector

Screening of soil during piezometer drilling and soil sampling was performed during the field investigation to provide immediate information as to the presence of volatile compounds. Field screening of soil during sampling at the AOCs was used to aid in determining which soil samples were submitted to the laboratory for analytical analysis.

During collection of soil samples, the air around the sampler was monitored with a Photovac Microtip™ PID immediately upon opening the sampler (to maximize the detection of volatiles). A portion of the soil sample was placed in glass 40-ml volatile organic analyses (VOA) vials, and the PID was used to conduct ambient temperature headspace analysis (ATHA) for photoionization compounds. PID and ATHA readings are shown on the boring logs presented in Appendix C.

Calibration of the PID was performed at the start of each day using 100 parts per million (ppm) isobutylene, a standard calibration gas. Additional calibrations were made during the day if unit readings became erratic or if the unit was turned off. A calibration log was maintained for all calibrations performed during the investigation and is included in the field notes in Appendix E. Calibration procedures were performed as outlined in the manufacturer's instructions.

5.2.2.3 Field Gas Chromatograph

Soil samples collected during piezometer and borehole drilling were also field screened using a Photovac Model 10S+™ Portable GC. The field GC, calibrated for BTEX, dichloroethylene (DCE), trichloroethylene (TCE), and tetrachloroethylene (PCE), was used to detect the presence of these compounds in the headspace from the soil samples. Data obtained from the field GC and PID was considered in selecting samples submitted for laboratory analysis. Field GC data is summarized in Section 6.0 for each AOC. All field GC screening results are presented in Appendix D.

The field GC was calibrated using a 100 parts per billion (ppb) BTEX, DCE, TCE, and PCE headspace standard for a 3-point calibration conducted each day prior to beginning sampling activities. This headspace standard was prepared daily by dilution of a 2,000 ppm stock solution for each target compound. The calibration was checked periodically during usage throughout the day, after approximately 10 sample analyses. Additionally, analysis of known concentrations of calibration standards (10 ppm, 1 ppm and 100 ppb) were conducted to check equipment sensitivity and performance. Air blank samples were used to assess any problems with sample or standard cross-contamination.

5.3 CONFIRMATION ACTIVITIES

Hart Environmental Drilling, Inc., of Chesterfield, Missouri, was retained as the drilling contractor for all hollow-stem auger (HSA) activities. The drilling contractor mobilized personnel and equipment that met or exceeded Missouri ANG and/or State of Missouri requirements.

Nytest Environmental, Incorporated (NEI) of Port Washington, New York, was retained to provide laboratory analysis services. Provisions were made by NEI for proper sample containers, labels, chain-of-custody forms, sample stabilization and preservation, and packing materials.

Lyman Surveyors and Engineers, of Saint Louis, Missouri, was retained as the surveying contractor. Buildings adjacent to each AOC, soil gas survey locations, and soil boring locations were surveyed. The land surface elevation of each soil boring location is shown on the soil boring logs in Appendix C.

5.3.1 Soil Borings

The objectives of the boring program were to obtain soil samples to screen for contamination at the AOCs and to obtain soil samples for laboratory analysis to determine if soil contamination was present. Soil samples were also used for determining site geology and subsurface soil characteristics. A total of 14 soil borings were drilled at the four AOCs, from which 37 soil samples were collected and submitted for laboratory analysis.

Soil borings were drilled by using HSA methods utilizing a trailer-mounted Central Mining Equipment (CME) Model 45C rig and 4.25-inch interior diameter (8.25-inch outside diameter) augers. The HSA drilling method employs a hollow helical steel drill tool (auger) that is rotated

to advance the boring and lift formation materials (cuttings) to the surface. The flights for the HSA are welded onto steel pipe and a cutter head is attached to the "lead" (bottom) auger to cut the hole. During drilling, a center bit is inserted into the hollow area of the cutter head that prevents cuttings from re-entering the hollow portion of the auger. Generally, the center bit is flush with, or extends no more than, 1/2 foot below the cutter head. The center bit connects through the auger flights by small-diameter drill rods and is attached to the top-head drive unit of the drill rig. The top-head drive is powered by an engine that mechanically rotates the entire flight of augers. The hollow opening allows the insertion of sampling tools (i.e., split-spoon sampler) with the augers in place to prevent caving of the borehole.

Samples were collected in soil below the land surface, at regular 5-foot intervals below the land surface, and immediately above bedrock or groundwater for field screening and subsurface characterization. An 18-inch carbon steel California-style sampler equipped with three 6-inch brass sleeves was used for collecting and containerizing soil samples. Where the depth to bedrock permitted, three soil samples were submitted for laboratory analysis from each boring location. The first sample was collected from the land surface or in soil immediately below gravel fill material. The second sample was obtained from the intermediate 5-foot interval sample that field screening indicated had the highest level of contamination. If field screening of all intermediate intervals showed no contamination, the interval following the surface interval was selected for laboratory analysis. The third sample was obtained from immediately above the groundwater or bedrock surface, whichever was encountered first. Actual sample depths submitted for laboratory analysis are discussed in Section 6.0, and are shown on the soil boring logs included in Appendix C. The California-style sampler was decontaminated in accordance with Work Plan protocols and new brass sleeves inserted before each sampling event.

Auger flights, drill rig(s), and tools were thoroughly steam-cleaned in the designated decontamination area (located directly east of Building 51) before initial use and after the completion of each borehole. Borehole abandonment activities conformed to applicable State of Missouri requirements. All borings were backfilled with pure bentonite grout at the end of each working day to prevent the downward migration of contaminants through the open borehole.

5.3.2 Surface Sediment Samples

The objective of sediment sampling was to obtain surface sediment samples for laboratory analysis to define any existing contamination in the open drainage ditch at AOC-C. A total of three locations within the drainage ditch were sampled.

Samples were collected using a decontaminated thin-wall brass sleeve to scoop surface sediments and place them inside 8-ounce, wide-mouth glass jars. The soil was compacted inside the jars to eliminate headspace and the jars were sealed with Teflon™-lined lids.

5.3.3 Piezometers

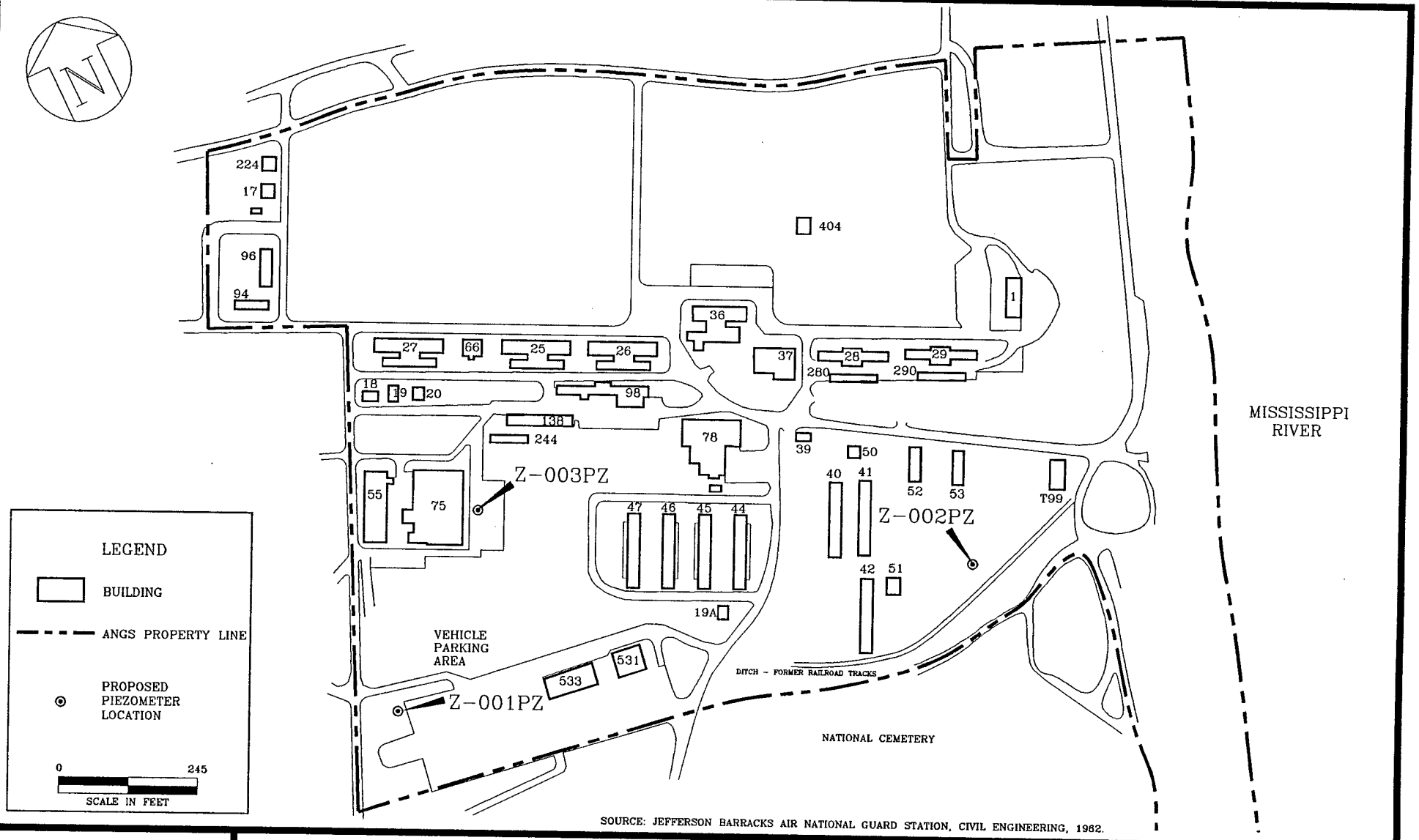
The installation of three piezometers was proposed in the SI Work Plan to obtain water levels to determine station-wide groundwater flow direction. These piezometers were to be installed if groundwater was encountered prior to reaching bedrock. During the field work, groundwater was encountered in only one of the three piezometer locations. The locations where boreholes for the proposed piezometers were drilled are shown on Figure 5.3. Additionally, groundwater was encountered in only 5 of 14 soil borings prior to reaching bedrock at the four AOCs. Since groundwater in the vicinity of the AOCs occurred sporadically as perched water above the bedrock, no piezometers were installed.

5.3.4 Specific Media Sampling

The analytical program developed for the SI at Jefferson Barracks ANGS was designed to identify contaminants in soil and surface sediments from past activities identified at the AOCs during the PA. The objective of the analytical program was to determine if contamination is present at the four AOCs in concentrations that warrant further investigation as an IRP site. To accomplish this objective, soil and surface sediment samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), TPH, and priority pollutant metals. Metals analysis include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. The analytical program specific to each AOC is listed in Table 5.1.

5.3.4.1 Soil Sample Preservation

Soil samples from soil borings submitted for laboratory analysis were collected with a California-style split-spoon sampler and contained in brass sleeves. Immediately upon removal from the sampler, the sleeve ends were covered with a Teflon™ barrier, aluminum foil, and fitted with a plastic cap. The sleeves were properly labeled, placed in plastic bags, stored in coolers, and chilled to 4° C or less.



SOURCE: JEFFERSON BARRACKS AIR NATIONAL GUARD STATION, CIVIL ENGINEERING, 1962.

FIGURE 5.3

JEFF\JEFFBASE

PROPOSED PIEZOMETERS (BOREHOLE LOCATIONS)

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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NOVEMBER 1996

Table 5.1
Analytical Program and Confirmation Activities Table
157th ACG, Jefferson Barracks ANGB, St. Louis, Missouri

AOC	Matrix	Field Parameters	Lab Parameters	USEPA Methods	Investigative Samples
A	Soil (Subsurface)	Field Screening using PID/Field GC Soil Classification	SVOCs Metals TPH	SW8270 SW6010[a] CA Mod. 8015[b]	9
B	Soil (Subsurface)	Field Screening using PID/Field GC Soil Classification	VOCs SVOCs Metals TPH	SW8240 SW8270 SW6010[a] CA Mod. 8015[b]	12
C	Soil (Subsurface)	Field Screening using PID/Field GC Soil Classification	VOCs SVOCs Metals TPH	SW8240 SW8270 SW6010[a] CA Mod. 8015[b]	10
	Soil (Sediment)	Field Screening using PID/Field GC Soil Classification	VOCs SVOCs Metals TPH	SW8240 SW8270 SW6010[a] CA Mod. 8015[b]	3
D	Soil (Subsurface)	Field Screening using PID/Field GC Soil Classification	SVOCs Metals TPH	SW8270 SW6010[a] CA Mod. 8015	6

[a]With the exception of arsenic (7060), lead (7421), mercury (7470), and selenium (7740).
[b]Extraction procedures for TPH are as follows: Volatile – SW5030; and Extractable – SW3550 (soil).
AOC – Area of Concern.
GC – Gas Chromatograph.
PID – Photoionization Detector.
TPH – Total Petroleum Hydrocarbons.
SVOC – Semivolatile Organic Compounds.
VOC – Volatile Organic Compounds.

Surface sediment samples submitted for laboratory analysis were collected with a thin-wall brass sleeve decontaminated immediately prior to sampling. Surface sediments were placed in two 8-ounce, wide-mouth glass jars with Teflon™-lined lids provided by the analytical laboratory. Immediately upon filling the sample collection jars, the jar was properly labeled, stored in coolers, and chilled to 4° C or less.

5.4 FIELD DOCUMENTATION AND INFORMATION COLLECTION

An open line of communication was maintained between the OpTech Project Manager, the project team at the station, and the ANGRC/CEVR Project Manager to ensure that all project objectives were met. Verifiable sample custody was an integral part of the field work. Samples were properly collected and identified and sampling activities were carried out in accordance with the PA/SI Work Plan. All information pertinent to field observations, screening and sampling were recorded in a bound notebook. Each member of the project team maintained a

field notebook in which details of daily field activities were recorded. A complete record of these field notebooks, as well as equipment calibration logs, soil description logs, and land survey plats are presented in Appendix E.

As part of field activities at the station and report preparation, information was obtained to complete the HRS "Data Requirements for Federal Facilities Docket Sites." This information is presented as Appendix F.

5.5 DEVIATIONS FROM THE WORK PLAN

There were deviations from the Work Plan. However, all deviations were approved by the ANGRC/CEVR Project Manager prior to being implemented. In no way did any of the changed procedures or protocols prevent accomplishing the overall objectives of this SI which were: to confirm the presence or absence of contamination; and to reach a decision point for each AOC.

The deviations from the Work Plan and the rationale for the changes are described as follows:

- Piezometers were not installed at Jefferson Barracks ANGS, due to the lack of a continuous aquifer above the bedrock. Z-001PZ and Z-002PZ were drilled at locations outlined in the Work Plan. Bedrock was encountered at Z-002PZ with no indication of groundwater. Groundwater was detected at Z-001PZ immediately above the bedrock. However, indications were that it was perched water of limited areal extent. Z-003PZ was relocated from its proposed location to a point 150 feet east of Building 75. It was drilled to the bedrock without encountering groundwater. Based on these results and subsequent soil boring information, piezometer installation was abandoned.

- One soil boring was moved from AOC-C to AOC-D. Thus, the number of borings drilled at AOC-D was increased from one to two. This was done to characterize the soil at a soil gas point at AOC-D that detected a high concentration of TPH contamination. The number of borings drilled at AOC-C was decreased from five to four. Soil gas survey findings did not indicate significant BTEX or TPH contamination, and the site could be adequately characterized using four soil borings.

- Only one soil sample was collected for laboratory analysis from C-001BH, and only two soil samples were collected for laboratory analysis from C-003BH,

C-004BH, and C-005BH. This was due to the shallow nature of the bedrock at these soil boring locations.

- Surface water samples were not collected from AOC-C for laboratory analysis. There was no water in the ditch during the duration of the field project, therefore, there was no surface water to be sampled.

- Decontamination of non-dedicated sampling equipment was not conducted using an ASTM Type II reagent water as specified in the Work Plan. Decontamination of sampling equipment was conducted using an ASTM Type I reagent water.

5.6 SITE INSPECTION DERIVED WASTE

During the SI, a certain amount of waste material (drill cuttings, decontamination water, personal protective equipment (PPE), and miscellaneous sample preparation wastes) were produced as a result of investigation activities. Soil cuttings from drilling locations and all decontamination water were drummed in steel, 55-gallon Department of Transportation (DOT) drums. Used PPE (Tyvek™ overalls), visqueen sheeting, paper towels, and soiled brass sleeves were also collected and stored in a steel, 55-gallon DOT drum and labeled as PPE. A total of 46 drums were produced; 25 containing soil cuttings, 20 containing decontamination water, and one containing PPE/refuse. All drums were properly marked to indicate their contents, including the collection date, contractor's name and phone number, and borehole ID number, decontamination water, or waste PPE.

Guidance for final disposition of drummed materials is provided in the following subsections. This information was provided to the Environmental Coordinator for Jefferson Barracks ANGS.

5.6.1 Drums Containing Soil

A total of 25 drums containing soil cuttings were produced during the SI. Cuttings from the piezometer locations were obtained from areas of no suspected contamination and were confirmed clean through field screening by field GC. No SVOCs or TPH were detected by laboratory analyses in investigative soil samples from AOC-A and AOC-D. The results of field GC analysis of soil from AOC-A and AOC-D indicated VOCs in de minimus concentrations in the samples not exceeding 15 ppb. No VOCs, SVOCs, or TPH were confirmed by laboratory analyses of soil samples from AOC-C. Investigative samples from AOC-B contained low concentrations of TPH and SVOCs and may require disposal as hazardous or industrial wastes.

Metals concentrations at the AOCs ranged widely; however, based on maximum total metal concentrations, only lead from one soil sample (at AOC-B) may exceed the Federal limit for the toxicity characteristic as outlined in 40 CFR 261.24 and may require disposal as a hazardous waste. Table 5.2 lists the drilling locations for which drums have been marked "Soil," the recommended disposition of those drums, and the rationale for each recommendation.

Table 5.2
Recommended Disposition of Soil Cuttings
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drum	Content Identification	Date Collected	Recommended Disposition	Rationale
1	Z-002PZ	12-7-94	Dispose soil on-site.	Cuttings obtained from an area of no suspected contamination.
2	Z-002PZ	12-7-94		
3	Z-001PZ	12-7-94		
4	Z-001PZ	12-7-94		
5	Z-003PZ	12-8-94		
6	D-001BH	12-9-94	Dispose soil on-site.	Analytical results from soil samples indicated no contamination in excess of state action levels.
7	D-001BH	12-9-94		
8	D-002BH	12-9-94		
9	C-001BH	12-9-94	Dispose soil on-site.	Analytical results from soil samples indicated no contamination in excess of state action levels.
10	C-001BH	12-12-94		
11	C-002BH	12-12-94		
12	C-002BH C-003BH	12-12-94		
13	C-004BH C-005BH	12-12-94		
14	B-001BH	12-13-94	Dispose through DRMO as TPH-contaminated soil.	Soil analysis results show TPH exceeds state action levels.
15	B-001BH	12-13-94		
16	B-002BH	12-13-94	Dispose soil on-site.	Analytical results from soil samples indicated no contamination in excess of state action levels.
17	B-002BH	12-13-94		
18	B-003BH	12-13-94	Dispose through DRMO as lead-contaminated soil.	Soil analysis results show lead could potentially exceed toxicity characteristic levels.
19	B-003BH	12-13-94		
20	B-004BH	12-14-94	Obtain permission from MDNR to dispose soil on-site.	Analytical results from soil samples indicated low levels of SVOC contamination.
21	B-004BH	12-14-94		

Table 5.2 (Concluded)
Recommended Disposition of Soil Cuttings
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drum	Content Identification	Date Collected	Recommended Disposition	Rationale
22	A-001BH	12-14-94	Dispose soil on-site.	Analytical results from soil samples indicated no contamination in excess of state action levels.
23	A-001BH A-002BH	12-14-94		
24	A-002BH	12-14-94		
25	A-003BH	12-14-94		

DRMO – Defense Reutilization and Marketing Office.
MDNR – Missouri Department of Natural Resources.
TPH – Total Petroleum Hydrocarbons.
SVOC – Semivolatile Organic Compounds.
PZ – Piezometer.
BH – Borehole.

Non-contaminated soils were disposed of onsite. Soils impacted by contaminants exceeding State action levels or metals concentrations high enough to potentially result in a leachate exceeding toxicity characteristic leaching procedure minimums were disposed of through the DRMO.

5.6.2 Drums Containing Non-Potable Water

Decontamination water was drummed separately from soil and was segregated by date of collection as outlined in Table 5.3. Considering the analytical results discussed in this section, and the few cases where contaminants were detected, the volume of water and the dilution of contaminants detected should permit disposal of decontamination water by the station.

Drummed waters were disposed of in the station oil/water separator system with approval granted by the Metropolitan Sewer District.

5.6.3 Drum Containing PPE and Other Wastes

One drum was used to contain used PPE and other miscellaneous wastes such as visqueen sheeting, paper towels, and used brass sleeves.

Table 5.3
Recommended Disposition of Decontamination Water
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drum(s)	Content Identification	Date Collected	Recommended Disposition	Rationale
1,2	Decon Water	12-7-94	Obtain permission from the City of St. Louis to dispose water through OWS connected to the city sewer system.	Analytical results of investigative soil samples indicated few cases where contamination was detected, and when contamination was detected, it only slightly exceeded detection and/or reporting limits.
3,4	Decon Water	12-8-94		
5,6	Decon Water	12-9-94		
7,8,9,10	Decon Water	12-12-94		
11,12,13	Decon Water	12-13-94		
14,15,16,17	Decon Water	12-14-94		
18,19,20	Decon Water	12-15-94		

OWS – Oil/Water Separator.

MDNR – Missouri Department of Natural Resources.

SECTION 6.0 INSPECTION PROGRAM FINDINGS

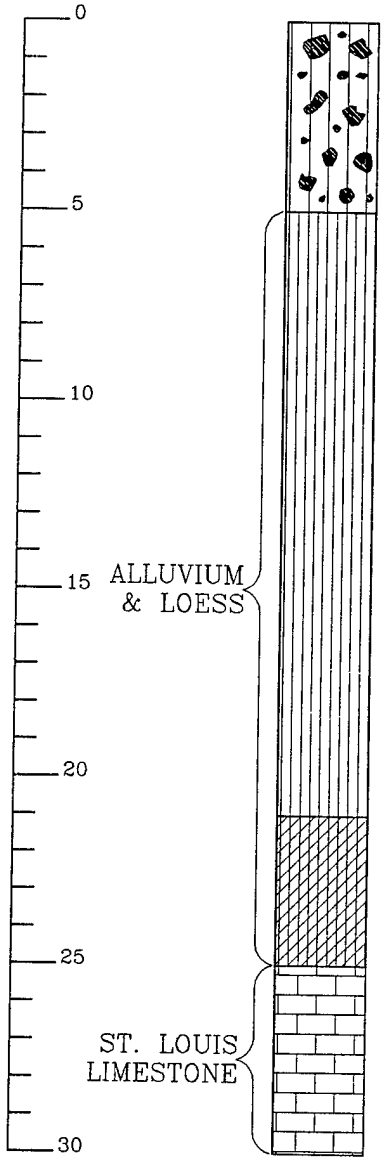
6.1 STATION SUBSURFACE GEOLOGY

Subsurface soil samples collected from piezometer borehole locations and soil borings were used to provide information to describe the subsurface geology and soil conditions at the station. The four AOCs are in close proximity to one another, and there was no significant variation observed in subsurface soil strata between them. The soil survey of St. Louis County indicates that only one soil type, the Harvester complex, is present at the station.

Soil characteristics encountered at Jefferson Barracks ANGS consisted of a topsoil layer extending to approximately 1.5 feet BLS, which was composed of a loose, dry, brown to dark brown organic-rich sand and silt loam. The surface material at AOC-A and AOC-D contained fill material composed of dark brown sand and silty sand with gravel and cement fragments to varying depths below the land surface. Below the topsoil or fill material was typical Harvester complex soil composed of brown and pale brown silt loam and silty clay loam. At several boring locations at AOC-A and AOC-B, subsurface material became more clay rich immediately above the bedrock surface. The clay and clayey silt was very moist, cohesive, and plastic. Groundwater occurs at the site as areally discontinuous, with perched accumulations within the clay and clayey silt deposits immediately overlying the limestone bedrock.

Bedrock at the station was composed of Mississippian-age limestone of the Meramecian Series (the St. Louis Limestone). It was a hard, gray, fossiliferous limestone that showed weathering and solution cavities in cuttings returned to the surface during drilling. A generalized stratigraphic section of the subsurface lithology at the station is shown in Figure 6.1. Complete lithologic descriptions are provided in the boring logs for piezometers and soil borings drilled during the SI in Appendix C.

Groundwater was not consistently detected in the borings drilled at the AOCs. No groundwater was detected in the four borings at AOC-C nor in the two borings at AOC-D. However, groundwater was detected in all three borings at AOC-A and in two of the four borings at AOC-B. In the three borings drilled for the installation of piezometers, groundwater was encountered in only one borehole. These inconsistencies confirm the unpredictability of groundwater in the limestone, which occurs along fractures, bedding planes, and in solution openings.



FILL MATERIAL	Dark brown to brown sandy clay loam with gravel, rock fragments. Loose, slightly moist.
SILT LOAM	Brown to dark brown silt and sandy silt loam. Very fine sand and silt. Cohesive, very slightly plastic, moist.
CLAY SILT LOAM	Brown silt and clay. Silty clay. Cohesive plastic, moist to wet.
BEDROCK	Limestone, gray, fossilferous, showing weathering and solution cavities in fragments returned to the surface

FIGURE 6.1

JEFF\GE02

GENERALIZED STRATIGRAPHIC COLUMN AT THE STATION

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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6.2 LABORATORY QUALITY ASSURANCE RESULTS FOR CONFIRMATION SAMPLES

No holding times were exceeded for any samples and no problems that affected analytical results were encountered. VOC and SVOC surrogate recoveries were within acceptable limits meeting required laboratory quality control criteria. Some SVOC samples and their associated method blanks experienced phthalate contamination at the laboratory. Phthalate compounds, when detected in samples at very low concentrations, usually indicate laboratory-induced contamination (USEPA, 1993). Several samples needed to be diluted due to sample matrix interference with internal standard areas. Therefore, some samples exhibited elevated detection limits. Some TPH samples showed a high hydrocarbon content (as seen in the chromatograms) that did not match the range of diesel fuel. However, since this hydrocarbon content saturated the analytical instrument, dilution of the sample was necessary to insure that diesel range organics were not present. Elevated detection limits are reported for those samples. A complete listing of the case narrative, internal standards, and laboratory QA/QC results are presented with the analytical results in Appendix G.

6.3 DISPOSAL AREA AOC (AOC-A)

AOC-A is located adjacent to the southeast corner of Building 42 as shown in Figure 6.2. The AOC measures approximately 35 feet wide and 60 feet long. The AOC is primarily covered with grass with a gravel roadway running diagonally across the site. To the south is a ditch where railroad tracks were previously located.

A geophysical survey, soil gas survey, and soil borings were used to evaluate physical and environmental conditions, confirm or deny contamination, and to characterize the subsurface geology and soil properties at the AOC. The geophysical survey indicated no subsurface structures or drilling hazards at the AOC, and no problems were encountered during drilling.

The soil boring locations for AOC-A are shown on Figure 6.2. Three soil borings were drilled at the locations originally proposed in the Work Plan. Soil boring A-001BH was drilled at the area where a pipe was believed to be located where used motor oil was reportedly disposed. Boring A-002BH was drilled on the gravel roadway topographically downslope of A-001BH to attempt to determine if any contamination had migrated in the downslope direction. Boring A-003BH, also located on the gravel roadway, was placed at SGS-6 to obtain soil samples where low concentrations of TPH were detected during the soil gas survey. This boring would also assist in determining the lateral extent of contamination, if detected.

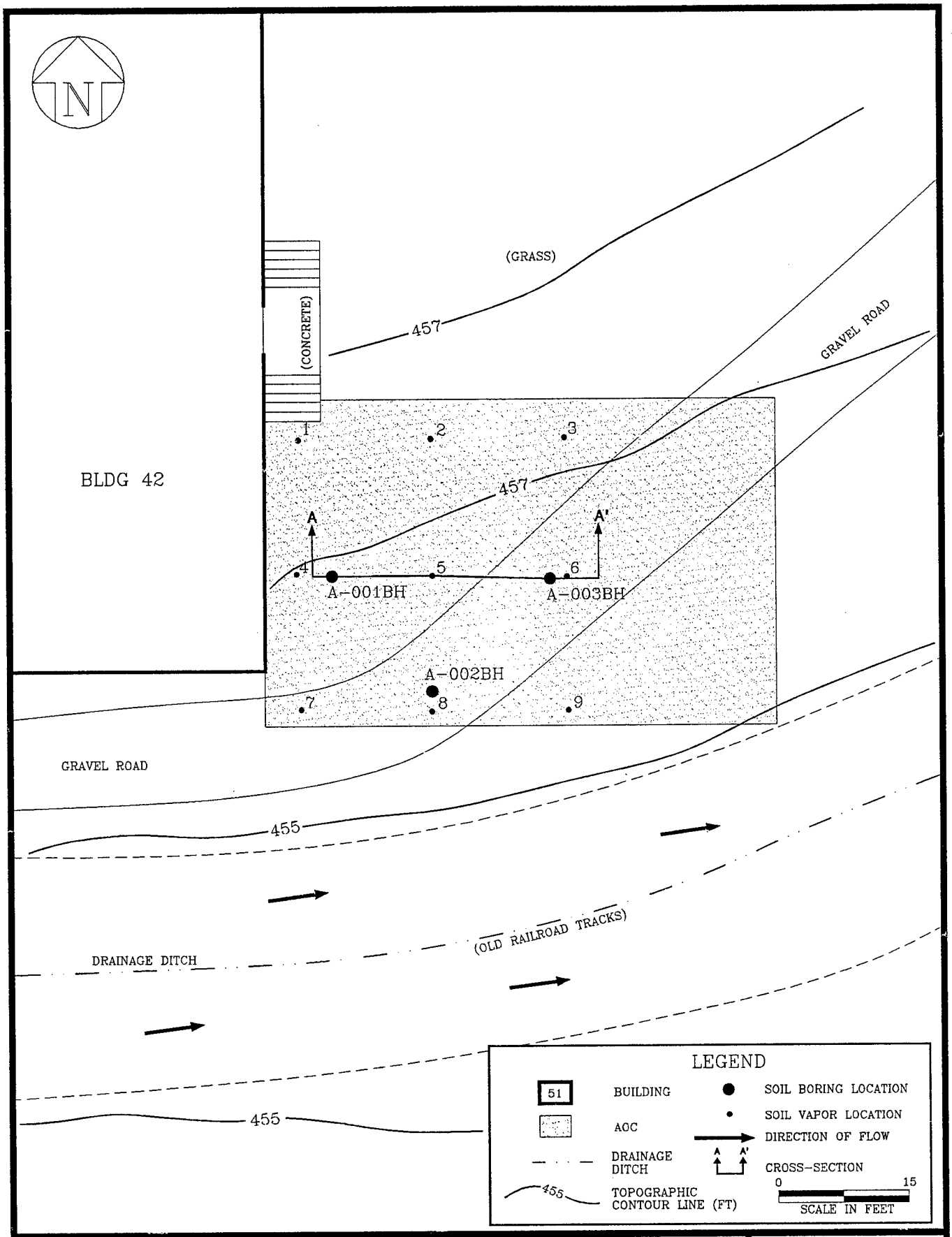

FIGURE 6.2

JEFF\INSPEC-A

INSPECTION ACTIVITIES AT DISPOSAL AREA AOC (AOC A)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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Boring A-001BH was drilled to a total depth of 23.0 feet BLS where bedrock was encountered. During sampling, groundwater was detected at 20.0 feet BLS. Groundwater appeared in boring A-001BH to occur in a very thin permeable zone approximately 2 to 3 feet above bedrock. Upon drilling boring A-001BH to confirm the top of bedrock, no groundwater was detected standing in the boring, suggesting that drainage of the water into bedrock fractures may have occurred. Boring A-002BH was drilled to a total depth of 21.5 feet BLS and terminated when groundwater was encountered at 19.0 feet BLS. Bedrock was not reached in the boring. Boring A-003BH was drilled to a total depth of 16.5 feet BLS and terminated when groundwater was encountered at 16.0 feet BLS. Bedrock was not reached in the boring. A geologic cross-section of AOC-A is presented in Figure 6.3.

6.3.1 Field Screening Results

A soil gas survey was conducted at the AOC to screen for BTEX and TPH contamination associated with used motor oil disposal. The locations of these soil gas sampling points are shown in Figure 6.2. A total of nine sampling points were arranged to cover the extent of the AOC. The soil gas sample was collected from a depth of 5.0 feet BLS by procedures outlined in Subsection 5.2.2.1.

TPH were detected in one soil gas sample from this AOC. Soil gas survey (SGS) #6 had TPH detected at 17 parts per million volume (ppmV), as shown in Figure 6.4. This value, covering the range C1 through C9, indicated a concentration expressed as hexane. No BTEX was detected in any soil gas sample from this AOC. The complete list of soil gas survey data is presented in Appendix B. Soil boring A-003BH was located at the SGS-6 location in order to submit a soil sample for laboratory analysis from the area where TPH were detected.

A total of 12 soil samples were screened for BTEX, DCE, TCE, and PCE with the field GC as outlined in Subsection 5.2.2.3 and two target compounds were detected at low concentrations in two samples. Benzene and ethylbenzene were detected at 2 ppb and 6 ppb in soil from A-001BH (10.0-11.5) and benzene was detected at 3 ppb from A-002BH (10.0-11.5). The very low concentrations did not indicate significant contamination was detected through field screening at this AOC. A complete list of field GC chromatograms and results are presented in Appendix D.

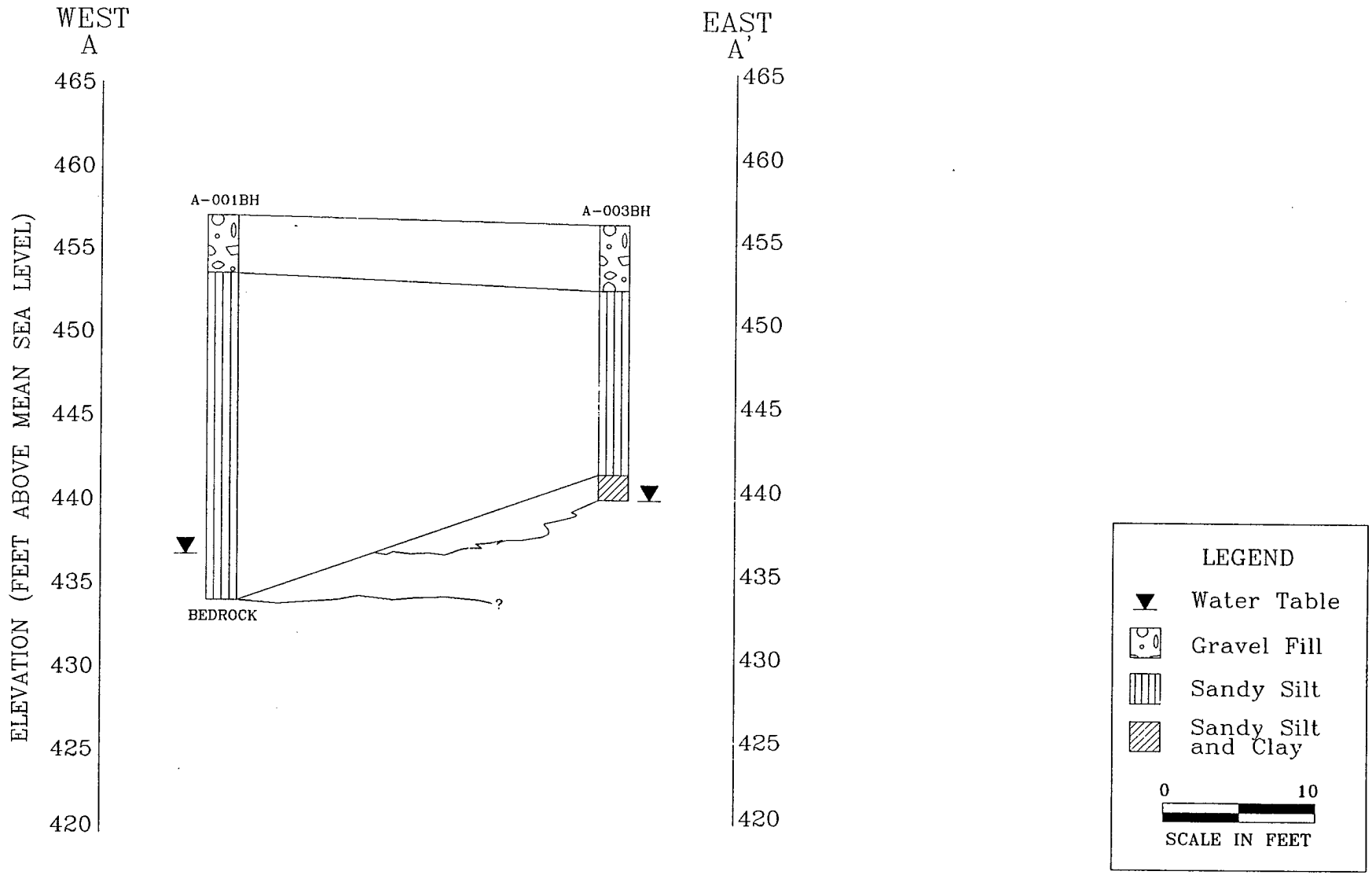

FIGURE 6.3

JEFF\CROS-A

GEOLOGIC CROSS-SECTION
OF DISPOSAL AREA AOC (AOC A)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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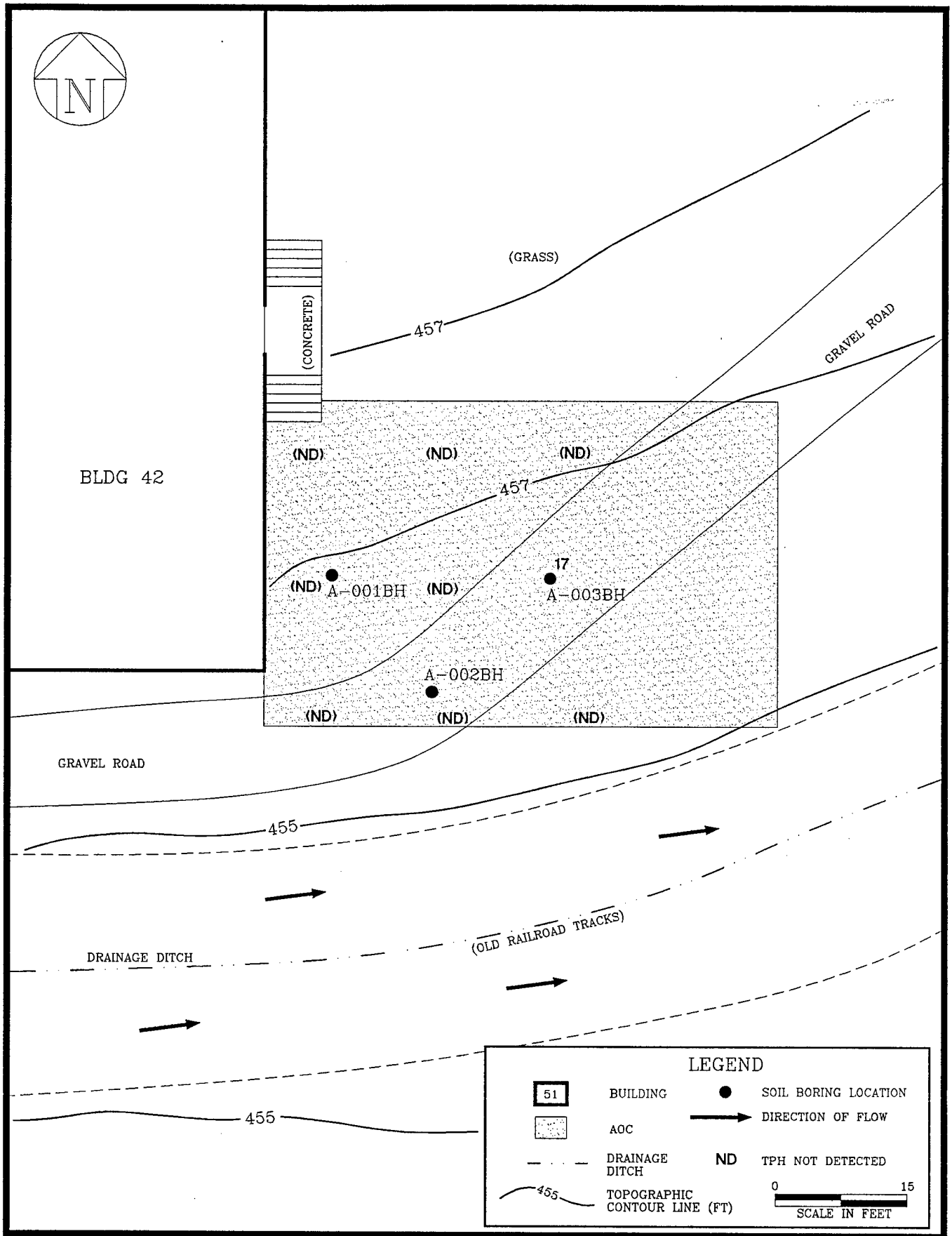

FIGURE 6.4

JEFF\INSPEC-A

TPH DETECTED DURING SOIL GAS SURVEY AT DISPOSAL AREA AOC (AOC A)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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6.3.2 Analytical Results

Three soil samples were collected from each boring for laboratory analysis. Table 6.1 lists the intervals where soil samples submitted for laboratory analysis were obtained. A total of nine soil samples were submitted for laboratory analysis for SVOCs, TPH, and metals. Bis(2-ethylhexyl)phthalate was detected at 720 micrograms per kilogram (μg/kg) in one sample. However, this was attributed to laboratory-induced contamination (USEPA, 1993). TPH were not detected in any sample from this AOC. The analytical range for TPH by Method 8015 (low- and high-boiling point hydrocarbons) detects hydrocarbons with carbon ranges from C2 to approximately C31, effectively covering the same range as the soil gas survey analyses with the exception of C1, methane. Field GC analysis did not indicate lighter hydrocarbons (VOCs) at concentrations greater than 6 ppb. Therefore, the non-detection of TPH by laboratory analysis and VOCs with the field GC indicates a possible methane detection by soil gas survey TPH results.

Table 6.1
AOC-A Drilling Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drilling Location/ Borehole Identification	Interval Submitted for Laboratory Analysis (Feet BLS)
A-001BH	
INT-1	3.5 - 5.0
INT-2	10.0 - 11.5
INT-3	20.0 - 21.5
A-002BH	
INT-1	1.0 - 2.5
INT-2	5.0 - 6.5
INT-3	20.0 - 21.5
A-003BH	
INT-1	4.0 - 5.5
INT-2	10.0 - 11.5
INT-3	15.0 - 16.5

AOC – Area of Concern. INT – Interval.
BLS – Below Land Surface.

Metals concentrations detected in soil samples from AOC-A are listed in Table 6.2 and shown on Figure 6.5. Antimony, cadmium, mercury, selenium, silver, and thallium were not detected in concentrations above method reporting limits. Arsenic concentrations ranged from 3.5 to 10.7 milligrams per kilogram (mg/kg), beryllium ranged from 0.26 to 0.73 mg/kg, chromium ranged from 9.8 to 31.5 mg/kg, copper ranged from 12.8 to 51.3 mg/kg, lead ranged from 10.6 to 88.5 mg/kg, nickel ranged from 13.6 to 19.9 mg/kg, and zinc ranged from 37.1 to 151 mg/kg.

Table 6.2
AOC-A Metals Analyses Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metals	A-001BH 3.5 - 5.0 (Ft BLS)	A-001BH 10.0 - 11.5 (Ft BLS)	A-001BH 20.0 - 21.5 (Ft BLS)	A-002BH 1.0 - 2.5 (Ft BLS)	A-002BH 5.0 - 6.5 (Ft BLS)	A-002BH 20.0 - 21.5 (Ft BLS)	A-003BH 4.0 - 5.5 (Ft BLS)	A-003BH 10.0 - 11.5 (Ft BLS)	A-003BH 15.0 - 16.5 (Ft BLS)
Arsenic	10.7	4.7	5.2	7.0	5.9	3.5	5.2	5.5	3.6
Beryllium	0.68	0.62	0.57B	0.47B	0.45B	0.73	0.26B	0.49B	0.34B
Cadmium	0.23U	0.44B	0.25U	0.24U	0.24U	0.24U	0.40B	0.25U	0.23U
Chromium	15.7	14.8	15.3	12.2	14.7	31.5	13.3	12.6	9.8
Copper	19.5	18.3	21.9	51.3	13.4	12.8	20.6	25.3	24.9
Lead	20	15.6	12.5	44.7	12.6	18.4	88.5	10.6	12.5
Nickel	19.9	19.8	16.2	14.2	19.8	16.2	14.2	16.8	13.6
Zinc	56.4	51.2	67.3	146	44.8	41.6	151	109	37.1

B – Sample value range greater than the instrument detection limit, but less than the reporting limit.
U – Indicates compound was analyzed for, but was not detected.

Ft – Feet.
AOC – Area of Concern.
BH – Borehole.
BLS – Below Land Surface.

Note: All analyte concentrations expressed in milligrams per kilogram (mg/kg). Analytical Methods: SW6010 with the exception of arsenic (SW7060), and lead (SW7421).

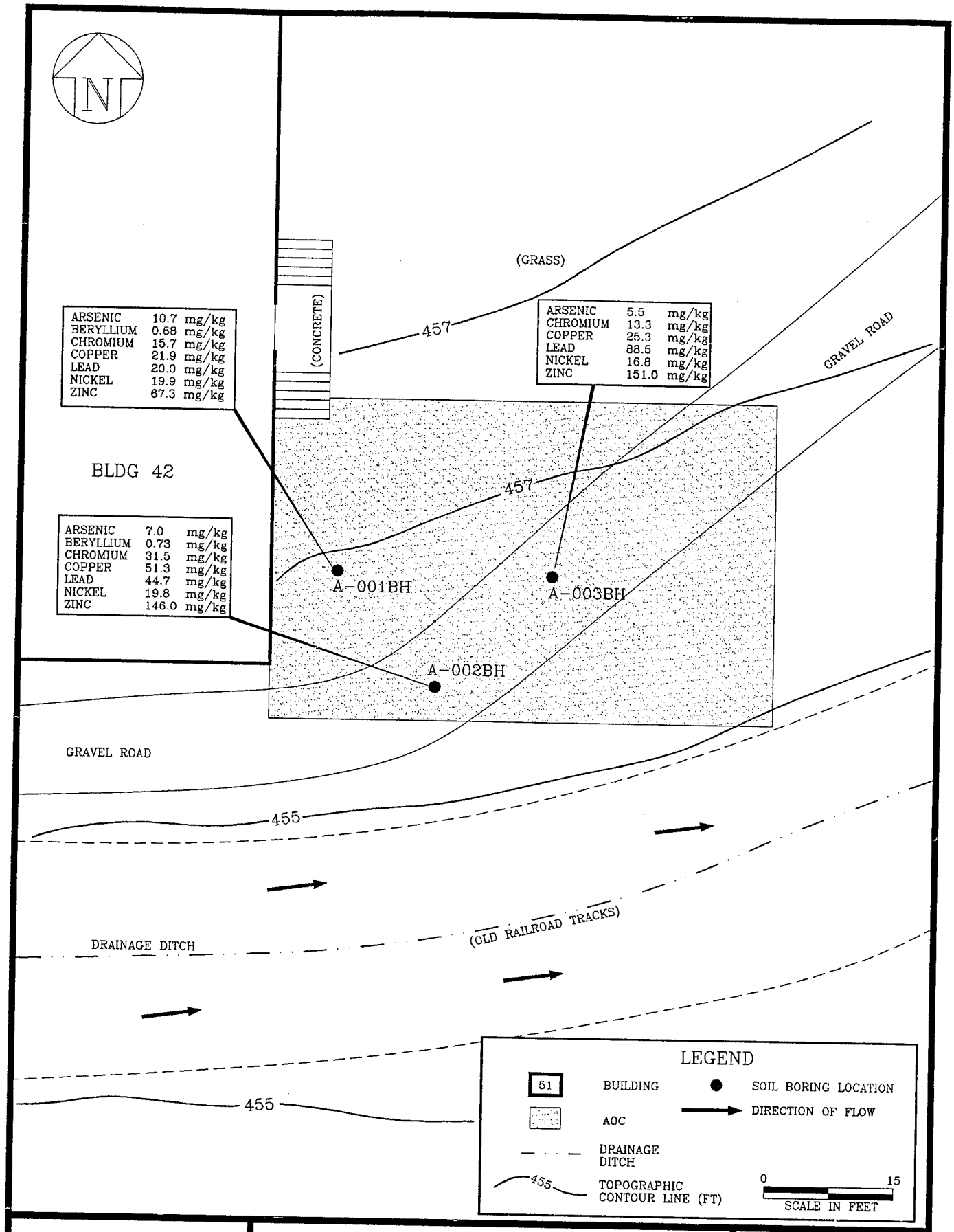

FIGURE 6.5

JEFF\INSPEC-A

RESULTS OF LABORATORY ANALYSES AT DISPOSAL AREA AOC (AOC A)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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6.4 STORAGE AREA AOC (AOC-B)

AOC-B is located south of Building 51 as shown in Figure 6.6. The AOC measures approximately 40 feet long and 60 feet wide and is currently used as a gravel-covered parking area for grounds maintenance vehicles and equipment. The 15-foot by 15-foot concrete pad constructed adjacent to Building 51 in 1991 was not included in the AOC for sampling purposes.

A soil gas survey and soil borings were used to evaluate environmental conditions, confirm or deny contamination, and to characterize the subsurface geology and soil properties at the AOC.

The soil boring locations for AOC-B are shown on Figure 6.3. Four soil borings were drilled at this AOC. The SI Work Plan proposed five borings at this location. However, as a result of soil gas results obtained from AOC-B and AOC-D, the ANGRC Project Manager approved the relocation of one boring from AOC-B to AOC-D. Borings B-001BH, B-002BH, and B-003BH were located in the area where drum storage was conducted, and where associated spillage was reported to have occurred. Boring B-004BH was drilled where a 3,000-gallon AST used to store waste oil was once located.

Borings B-001BH and B-002BH were drilled to a total depth of 31.5 feet BLS and 30.5 feet BLS, respectively, where bedrock was encountered. Groundwater was not observed at these boring locations. Boring B-003BH was drilled to a total depth of 30.0 feet BLS. Groundwater was encountered at approximately 28.0 feet BLS in that boring. Water level measurements prior to borehole abandonment indicated a water level of 28.3 feet BLS. Boring B-004BH was drilled to a total depth of 31.5 feet BLS. Groundwater was encountered at approximately 27.0 feet BLS in that boring. Water level measurements prior to borehole abandonment indicated a water level of 28.0 feet BLS. Drilling was terminated upon reaching groundwater at B-003BH and B-004BH; thus, bedrock was not encountered in these borings. A geologic cross-section of AOC-B is presented in Figure 6.7.

6.4.1 Field Screening Results

A soil gas survey was conducted at the AOC to screen for BTEX and TPH contamination associated with possible spillage from waste oil and solvent storage. The locations of these soil gas sampling points are shown in Figure 6.8. A total of 11 sampling points were arranged to cover the extent of the AOC. The soil gas sample was collected from a depth of 5.0 feet BLS by procedures outlined in Subsection 5.2.2.1.

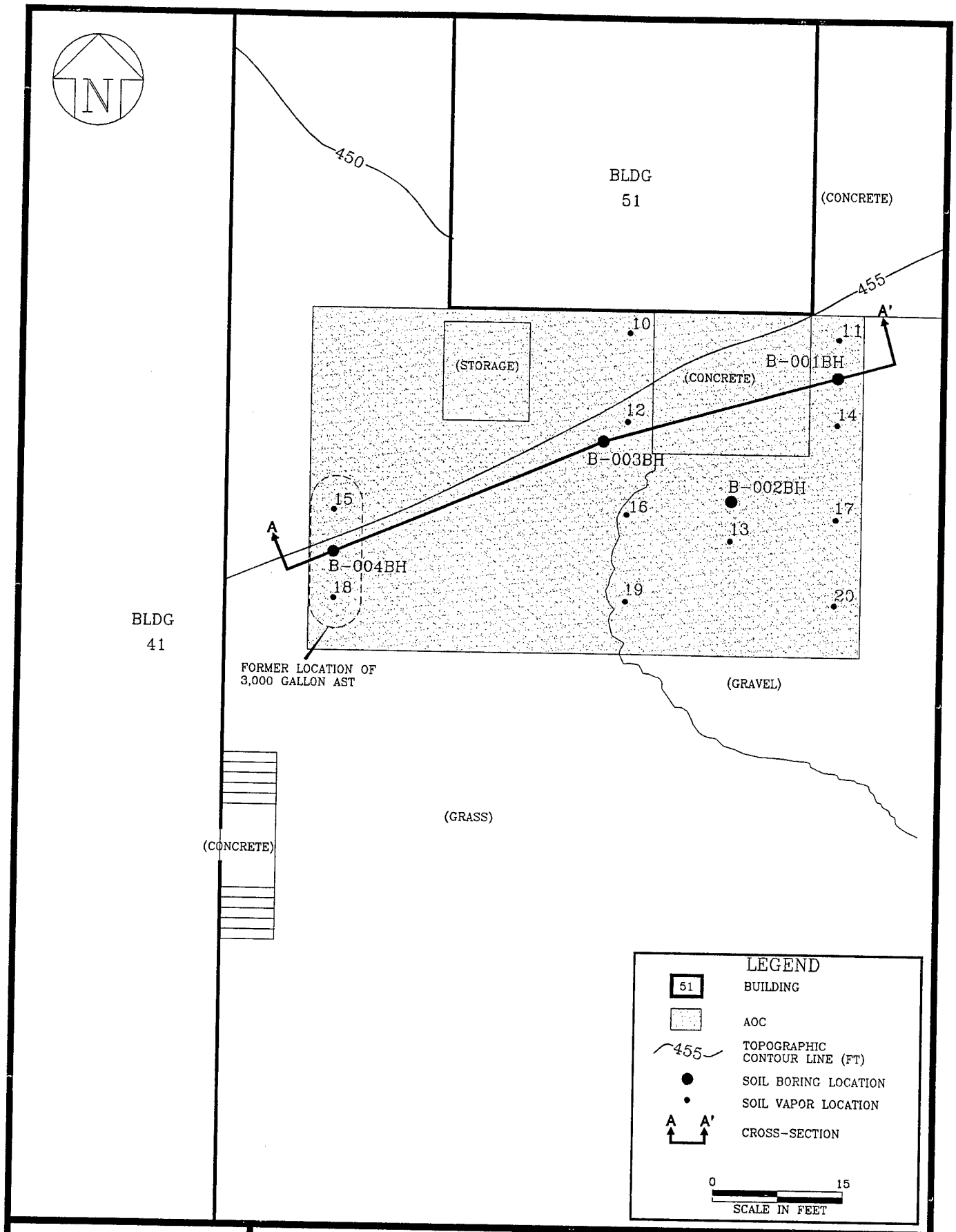

FIGURE 6.6

JEFF\INSPEC-B

INSPECTION ACTIVITIES AT
STORAGE AREA AOC (AOC B)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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CORPORATION

AUGUST 1996

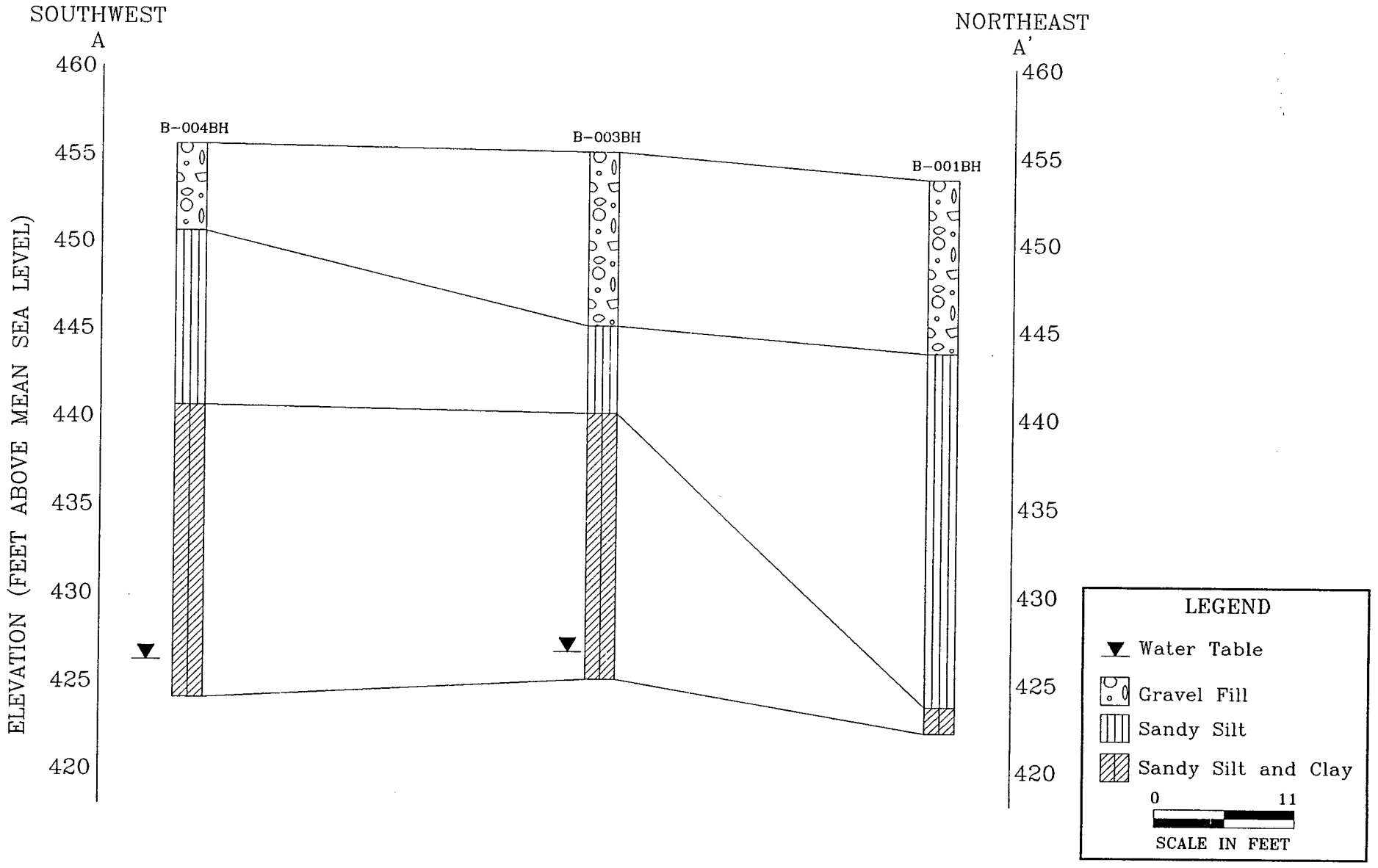

FIGURE 6.7

JEFF/CROS-B

GEOLOGIC CROSS-SECTION OF STORAGE AREA AOC (AOC B)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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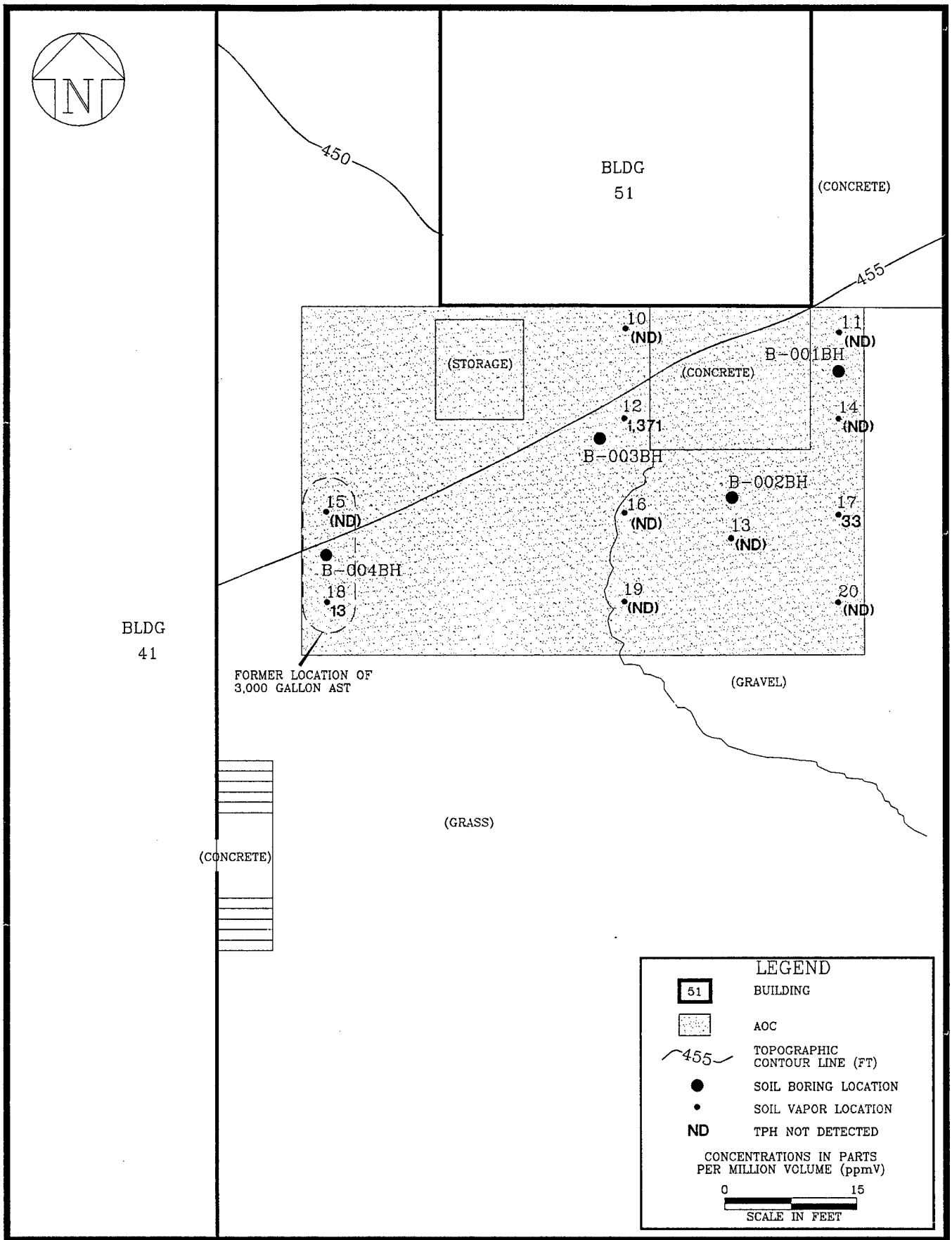

FIGURE 6.8

JEFF\INSPEC-B

TPH DETECTED DURING SOIL GAS SURVEY AT STORAGE AREA AOC (AOC B)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

AUGUST 1996

TPH were detected in three soil gas samples from this AOC, as shown in Figure 6.8. TPH were detected at SGS-12, SGS-17, and SGS-18 at 1,371, 33, and 13 ppmV, respectively. These values, covering the range C1 through C9, indicated a concentration expressed as hexane. Toluene, ethylbenzene, and xylene was detected in one soil gas sample from this AOC. SGS-12 contained toluene, ethylbenzene, and xylenes detected at 8.7, 4.0, and 22.5 micrograms per liter (μg/L), respectively. Complete soil gas survey data is presented in Appendix B. Soil boring B-003BH was located at the SGS-12 location and B-004BH was located near SGS-18 in order to submit a soil sample for laboratory analysis from the areas where possible contaminants were detected.

A total of 25 soil samples were screened for BTEX, DCE, TCE, and PCE with the field GC, as outlined in Subsection 5.2.2.3. Benzene was detected in all samples, ranging from 1 to 31 ppb (Figure 6.9). Toluene was detected in four samples, ranging from 1 to 23 ppb. Ethylbenzene was detected in three samples, ranging from 6 to 38 ppb. Xylenes were detected in two samples, ranging from 21 to 26 ppb. TCE was detected in 19 samples, ranging from 1 to 47 ppb (Figure 6.10). PCE was detected in nine samples, ranging from 2 to 101 ppb (Figure 6.11). Screening results were used to select the soil samples indicating the greatest concentration of target compounds for laboratory analysis. Complete field GC chromatograms and results are presented in Appendix D.

6.4.2 Analytical Results

Three soil samples were collected from each boring for laboratory analysis. Table 6.3 lists the intervals where soil samples were obtained that were submitted for laboratory analysis.

A total of 12 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and metals. VOCs were not detected in soil from any sample from this AOC. Volatile compounds (ranging from 1 to 47 ppb) detected during screening with the field GC were attributed to minor method cross contamination. Additionally, the laboratory USEPA method quantification limit for the VOCs detected ranged from 11 to 14 ppb, which was higher than the detection limit of 1 ppb for the field GC; therefore, true VOC concentrations in soil samples less than the laboratory USEPA method quantification limit would not be detected.

SVOCs were detected in two soil samples from this AOC. The SVOCs detected were all polyaromatic hydrocarbons (PAHs), and concentrations ranged from 240 to 2,500 μg/kg. Fluoranthene and pyrene were detected in soil from B-003BH (1.0-2.5) and fluoranthene, pyrene, phenanthrene, anthracene, chrysene, benzo(a)anthracene, benzo(k)fluoranthene, and

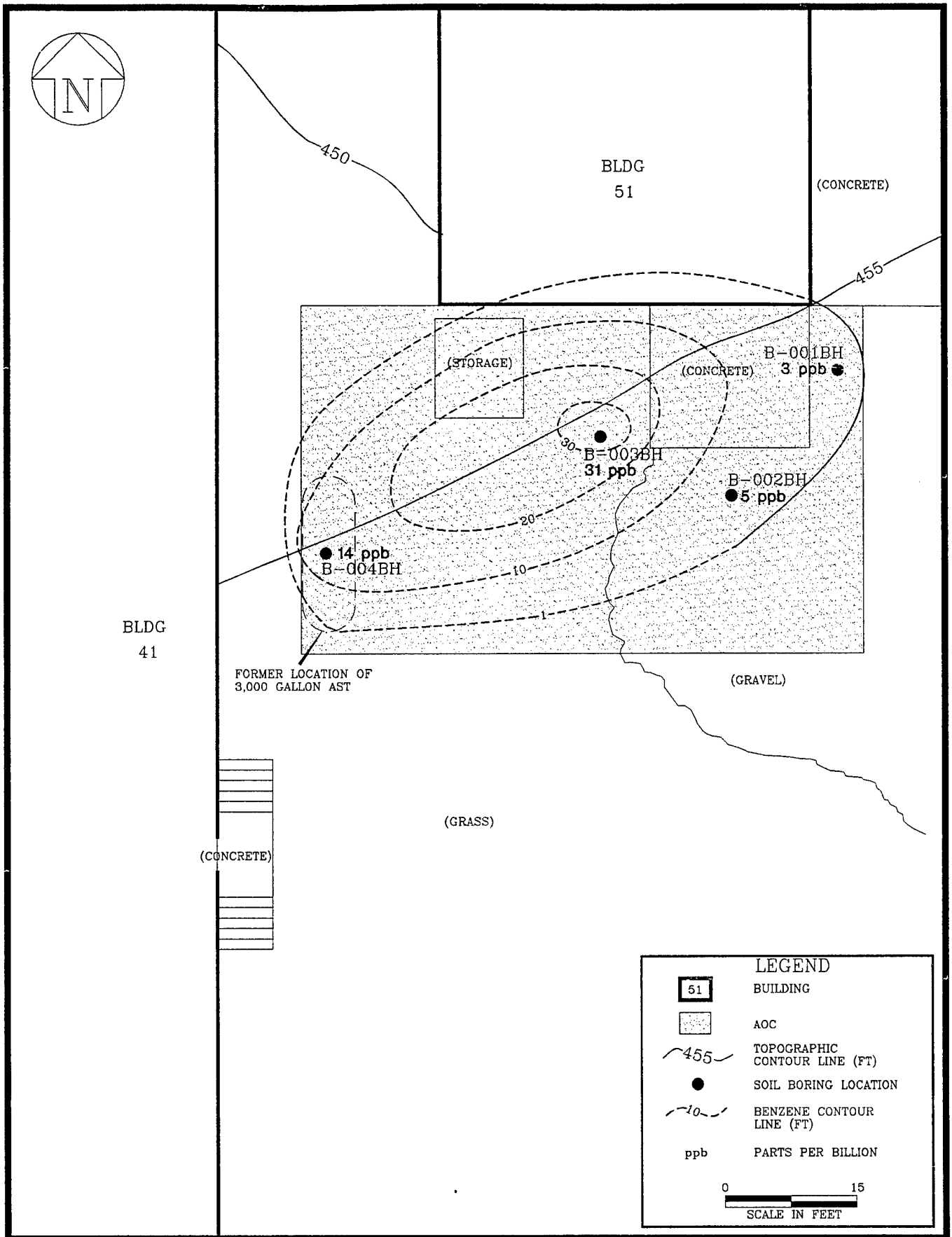

FIGURE 6.9

JEFF\INSPEC-B

BENZENE DETECTED IN FIELD GC SCREENING AT STORAGE AREA AOC (AOC B)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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AUGUST 1996

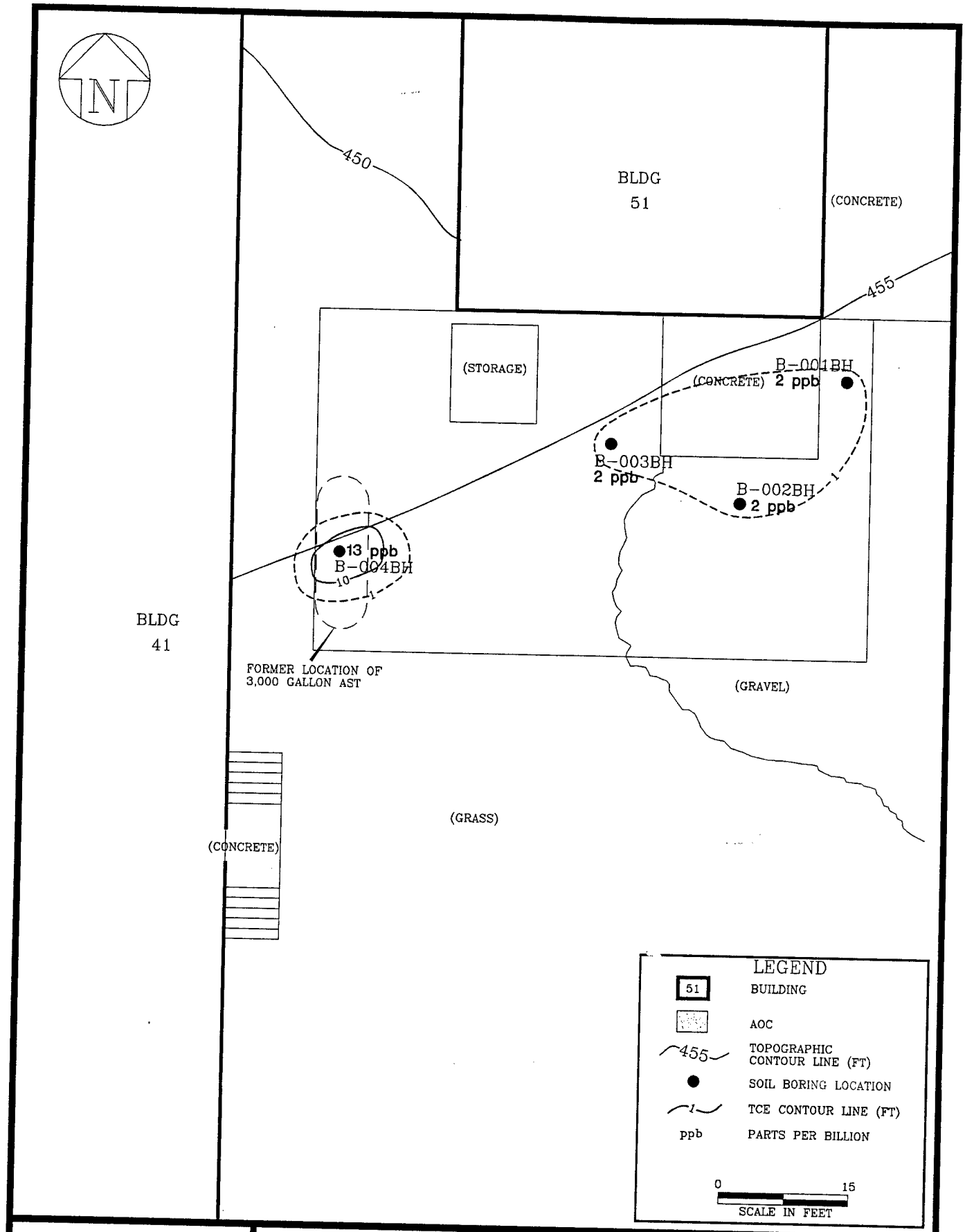

FIGURE 6.10

JEFF\INSPEC-B

TCE DETECTED IN FIELD GC SCREENING AT STORAGE AREA AOC (AOC B)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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OPERATIONAL TECHNOLOGIES CORPORATION

AUGUST 1996

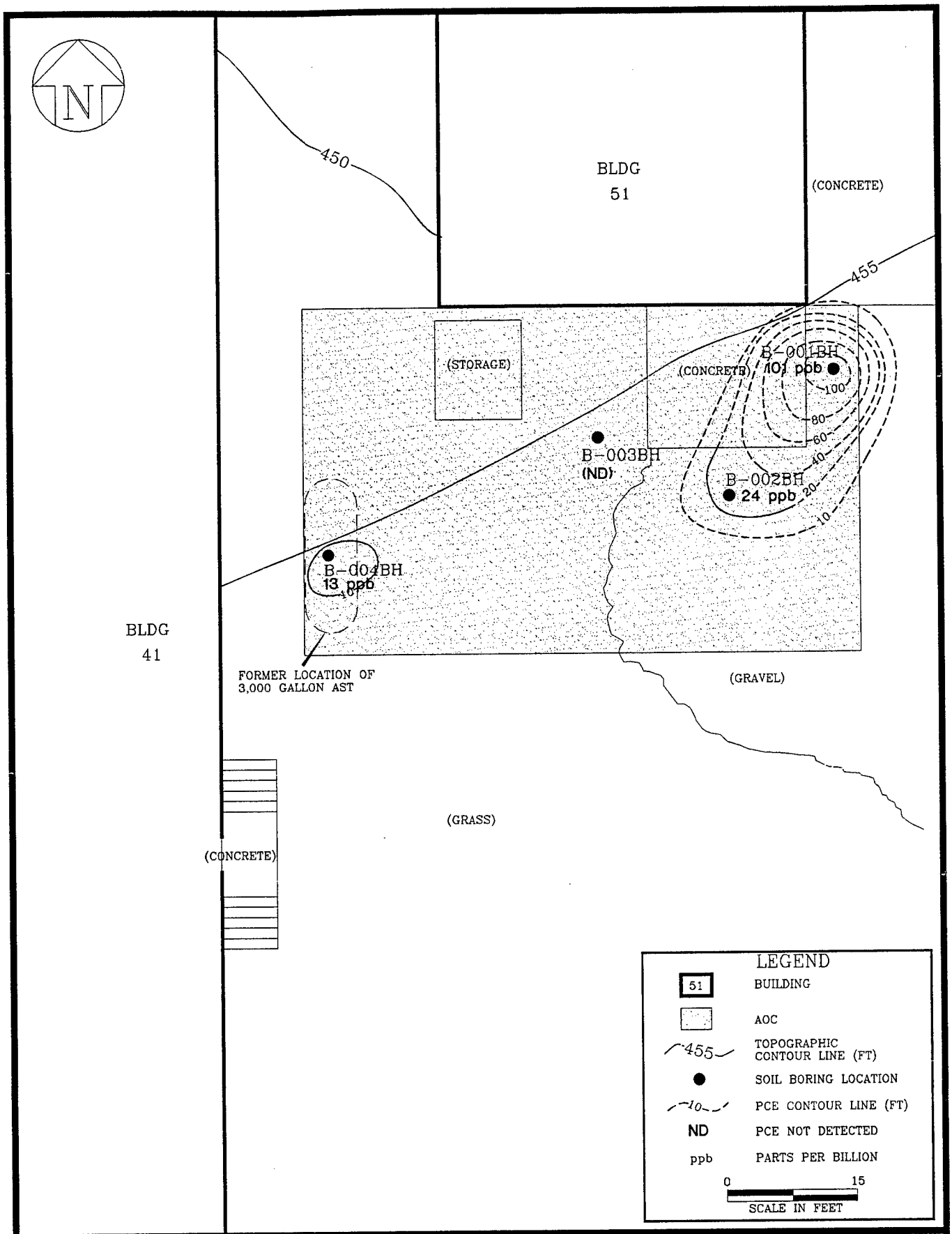

FIGURE 6.11

JEFF\INSPEC-B

PCE DETECTED IN FIELD GC SCREENING AT STORAGE AREA AOC (AOC B)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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Table 6.3
AOC-B Drilling Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drilling Location/ Borehole Identification	Interval Submitted for Laboratory analysis (Feet BLS)
B-001BH	
INT-1	3.5 - 5.0
INT-2	10.0 - 11.5
INT-3	30.0 - 31.5
B-002BH	
INT-1	0.5 - 2.0
INT-2	5.0 - 6.5
INT-3	29.0 - 30.5
B-003BH	
INT-1	1.0 - 2.5
INT-2	5.0 - 6.5
INT-3	25.0 - 26.5
B-004BH	
INT-1	0.5 - 2.0
INT-2	10.0 - 11.5
INT-3	30.0 - 31.5

AOC – Area of Concern.
BLS – Below Land Surface.
INT – Interval.

benzo(a)pyrene were detected in soil from B-004BH (0.5-2.0) at concentrations shown on Table 6.4. Bis(2-ethylhexyl)phthalate was also detected at B-004BH. However this is attributed to laboratory-induced contamination. TPH results for AOC-B are shown in Table 6.5 and are presented on Figure 6.12. TPH analysis indicated #2 Fuel Oil was detected in B-001BH (3.5-5.0) and (30.0-31.5) at 440 and 100 mg/kg, respectively. Several other TPH quantities were reported as a particular hydrocarbon when the peak pattern did not match that of the reference standard. These quantities were detected in B-001BH (3.5-5.0) and reported TPH as lube oil at 39 mg/kg, and TPH as gasoline at 0.9 mg/kg. B-001BH (30.0-31.5) reported TPH as C20 at 4.1 mg/kg. B-003BH (5.0-6.5) reported TPH as C20 at 3.3 mg/kg.

Metals concentrations detected in soil samples from AOC-B are listed in Table 6.6 and shown on Figure 6.12. Antimony, mercury, selenium, silver, and thallium were not detected in concentrations above method reporting limits. Arsenic concentrations ranged from 2.0 to 10.6 mg/kg, beryllium ranged from non-detect to 1.3 mg/kg, cadmium ranged from non-detect to 2.6 mg/kg, chromium ranged from 8.6 to 39.6 mg/kg, copper ranged from 14.7 to 54.3 mg/kg, lead ranged from 7.1 to 133 mg/kg, nickel ranged from 10.7 to 38.9 mg/kg, and zinc ranged from 38.6 to 710 mg/kg.

Table 6.4
Semivolatile Organic Compounds Detected in Soil at AOC-B
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Analyte		Boring Identification/Interval (feet BLS)	
		B-003BH (1.0 - 2.5) (µg/kg)	B-004BH (0.5 - 2.0) (µg/kg)
SVOCs	Fluoranthene	900	2,400
	Pyrene	790	2,400
	Phenanthrene	620J	2,500
	Anthracene	110J	470
	Chrysene	400J	990
	Benzo(a)anthracene	350J	910
	Benzo(k)fluoranthene	190J	420
	Benzo(a)pyrene	220J	530
	Bis(2-ethylhexyl)phthalate*	780U	700

SVOCs – Semivolatile Organic Compounds by Method SW8270.
µg/kg – micrograms per kilogram.
BH – Borehole.
BLS – Below Land Surface.
U – Compound was analyzed for but was not detected. Detection limit is shown.
J – Indicates an estimated concentration. Indicates the presence of the compound that meets the identification criteria, but the result is less than the sample quantitation limit for the sample.
* – Common laboratory induced contaminant in SVOC analysis (USEPA, 1993).

Table 6.5
TPH Detected in Soil at AOC-B
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Analyte		Boring Identification/Interval (feet BLS)			
		B-001BH (3.5 - 5.0) (mg/kg)	B-001BH (30.0 - 31.5) (mg/kg)	B-003BH (5.0 - 6.5) (mg/kg)	B-004BH (0.5 - 2.0) (mg/kg)
TPH	TPH as #2 Fuel Oil	440	100	12U	12U
	TPH as Lube Oil	39	13U	12U	12U
	TPH as C20	11U	4.1	3.3	12U
	TPH as Gasoline	0.89	0.13U	0.12U	0.12U

TPH – Total Petroleum Hydrocarbons by Method CA. 8015 Modified.
BLS – Below Land Surface.
mg/kg – milligrams per kilogram.
BH – Borehole.
U – Compound was analyzed for but was not detected. Detection limit is shown.

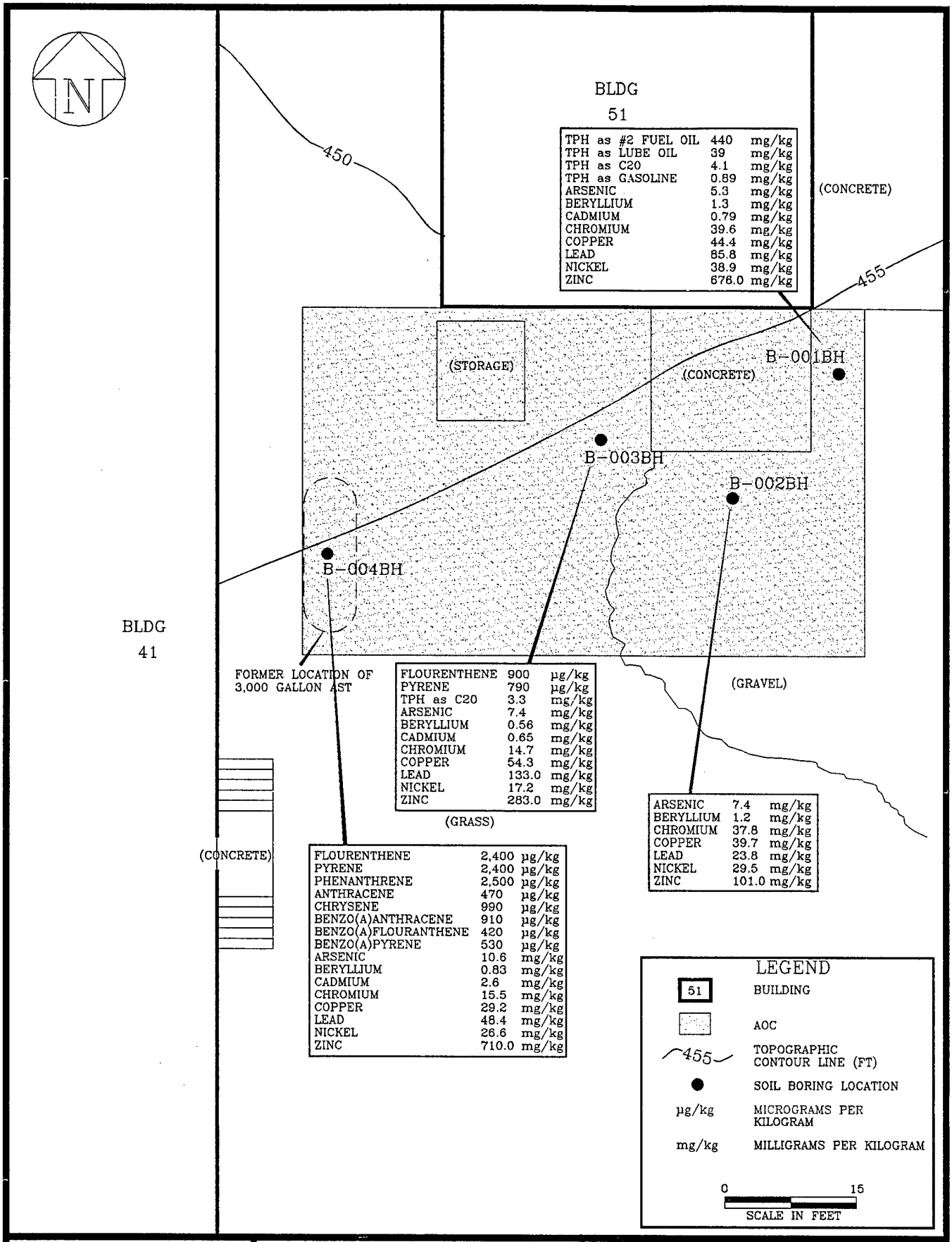

FIGURE 6.12

JEFF\INSPEC-B

RESULTS OF LABORATORY ANALYSES AT STORAGE AREA AOC (AOC B)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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Table 6.6
AOC-B Metals Analyses Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metals	B-001BH 3.5 - 5.0 (Ft BLS)	B-001BH 10.0 - 11.5 (Ft BLS)	B-001BH 30.0 - 31.5 (Ft BLS)	B-002BH 0.5 - 2.0 (Ft BLS)	B-002BH 5.0 - 6.5 (Ft BLS)	B-002BH 29.0 - 30.5 (Ft BLS)
Antimony	3.8U	4.7U	4.7U	5.6B	4.6U	5.1U
Arsenic	2.2	5.3	2.6	6.6	7.4	5.0
Beryllium	0.10U	0.42B	1.3	0.44B	0.47B	1.2
Cadmium	0.79	0.25U	0.43B	0.22U	0.24U	0.27U
Chromium	10.7	12.8	39.6	11.4	8.6	37.8
Copper	15.4	44.4	25.5	14.7	39.7	18.8
Lead	85.8	15.8	17.4	23.8	8.4	19.6
Nickel	12.1	20	38.9	14.1	23	29.5
Zinc	676	148	83.1	52.6	101	63.6
Metals	**B-003BH 1.0 - 2.5 (Ft BLS)**	**B-003BH 5.0 - 6.5 (Ft BLS)**	**B-003BH 25.0 - 26.5 (Ft BLS)**	**B-004BH 0.5 - 2.0 (Ft BLS)**	**B-004BH 10.0 - 11.5 (Ft BLS)**	**B-004BH 25.0 - 31.5 (Ft BLS)**
Antimony	4.2U	4.4U	4.5U	4.5U	4.5U	4.1U
Arsenic	7.4	7.2	4.7	7.1	10.6	2.0
Beryllium	0.56	0.46B	0.59B	0.79	0.83	0.22U
Cadmium	0.65	0.23U	0.24U	2.6	0.78	0.22U
Chromium	13.2	11.4	14.7	15.5	14.2	12.9
Copper	25.2	54.3	34.6	29.2	21.3	19.6
Lead	133	79.8	14.2	48.4	13.3	7.1
Nickel	15.6	15.1	17.2	22.2	26.6	10.7
Zinc	283	149	45.7	710	79.7	38.6

U – Indicates compound was analyzed for but was not detected.
B – Sample value range greater than the instrument detection limit, but less than the reporting limit.
AOC – Area of Concern.
BH – Borehole.
BLS – Below Land Surface.
Ft. – Feet.
Note: All analyte concentrations expressed in milligrams per kilogram (mg/kg). Analytical Methods: SW6010 with the exception of arsenic (SW7060), and lead (SW7421).

6.5 DRAINAGE DITCH AOC (AOC-C)

AOC-C is located approximately 150 feet south of Building 75 and is immediately north of a military vehicle parking area (see Figure 6.13). The AOC measures approximately 375 feet long and 10 feet wide and centers on the ditch that is the subject of the investigation. A large majority of the area is grass covered, with a culvert and gravel road passing over the ditch near the west end of the AOC. The soil boring locations for AOC-C are shown on Figure 6.13. Five soil borings were drilled at this AOC. Borings C-001BH, C-002BH, C-003BH, C-004BH,

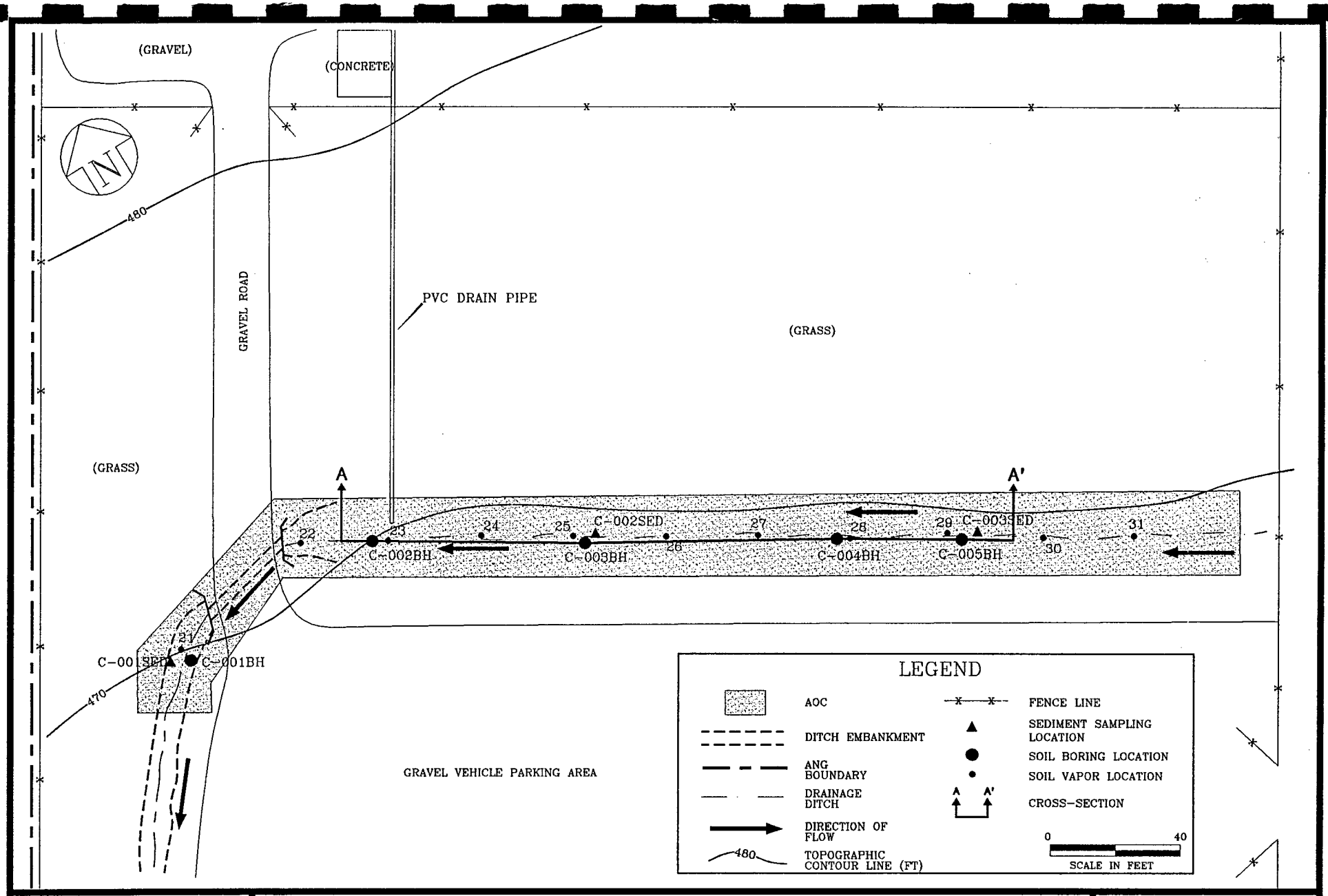

FIGURE 6.13

JEFF\INSPEC-C

INSPECTION ACTIVITIES AT DRAINAGE DITCH AOC (AOC C)

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and C-005BH were located along the centerline of the ditch at equally spaced intervals along the length of the AOC.

Boring C-001BH was drilled in the ditch west of the culvert for the gravel road leading down from the OMS Building (Building 55). It was drilled to a total depth of 5.0 feet BLS, where bedrock was encountered. One additional boring was attempted adjacent to the C-001BH location to confirm bedrock. This boring also encountered bedrock at approximately 4.5 feet BLS. Due to the shallow nature of bedrock at this location, only one soil sample was obtained for laboratory analysis. Boring C-002BH was drilled at the outfall of the PVC pipe, to a total depth of 13.5 feet BLS, where bedrock was encountered. Three soil samples for laboratory analysis were obtained from this boring location. Borings C-003BH, C-004BH, and C-005BH were drilled to a total depth of 7.5 feet, 6.5 feet, and 6.0 feet BLS, respectively, where bedrock was encountered. Two soil samples for laboratory analysis were obtained from each boring location. Groundwater was not encountered in any boring location at this AOC. A geologic cross-section of AOC-C is presented in Figure 6.14.

A soil gas survey and soil borings were used to evaluate environmental conditions, confirm or deny contamination, and to characterize the subsurface geology and soil properties at the AOC.

6.5.1 Field Screening Results

A soil gas survey was conducted at the AOC to screen for BTEX and TPH associated with possible contamination from nearby vehicle maintenance and steam cleaning activities. The locations of these soil gas sampling points are shown in Figure 6.13. A total of 11 sampling points were arranged to cover the extent of the AOC. The soil gas sample was collected from a depth of 5.0 feet BLS by procedures outlined in Subsection 5.2.2.1.

TPH were detected in one soil gas sample from this AOC (Figure 6.15). TPH were detected at SGS-26 at 33 ppmV. This value, covering the range C1 through C9, indicated a concentration expressed as hexane. No BTEX was detected in any soil gas samples from this AOC. Complete soil gas survey data is presented in Appendix B. Soil boring C-003BH was located near the SGS-25 location and provided a soil sample for laboratory analysis from the area near where soil gas TPH was detected.

A total of 11 soil samples were screened for BTEX, DCE, TCE, and PCE with the field GC as outlined in Subsection 5.2.2.3. Benzene was detected in nine samples, ranging from 2 to 22 ppb (Figure 6.16). Toluene was detected in three samples at 1 ppb in each. TCE was detected in

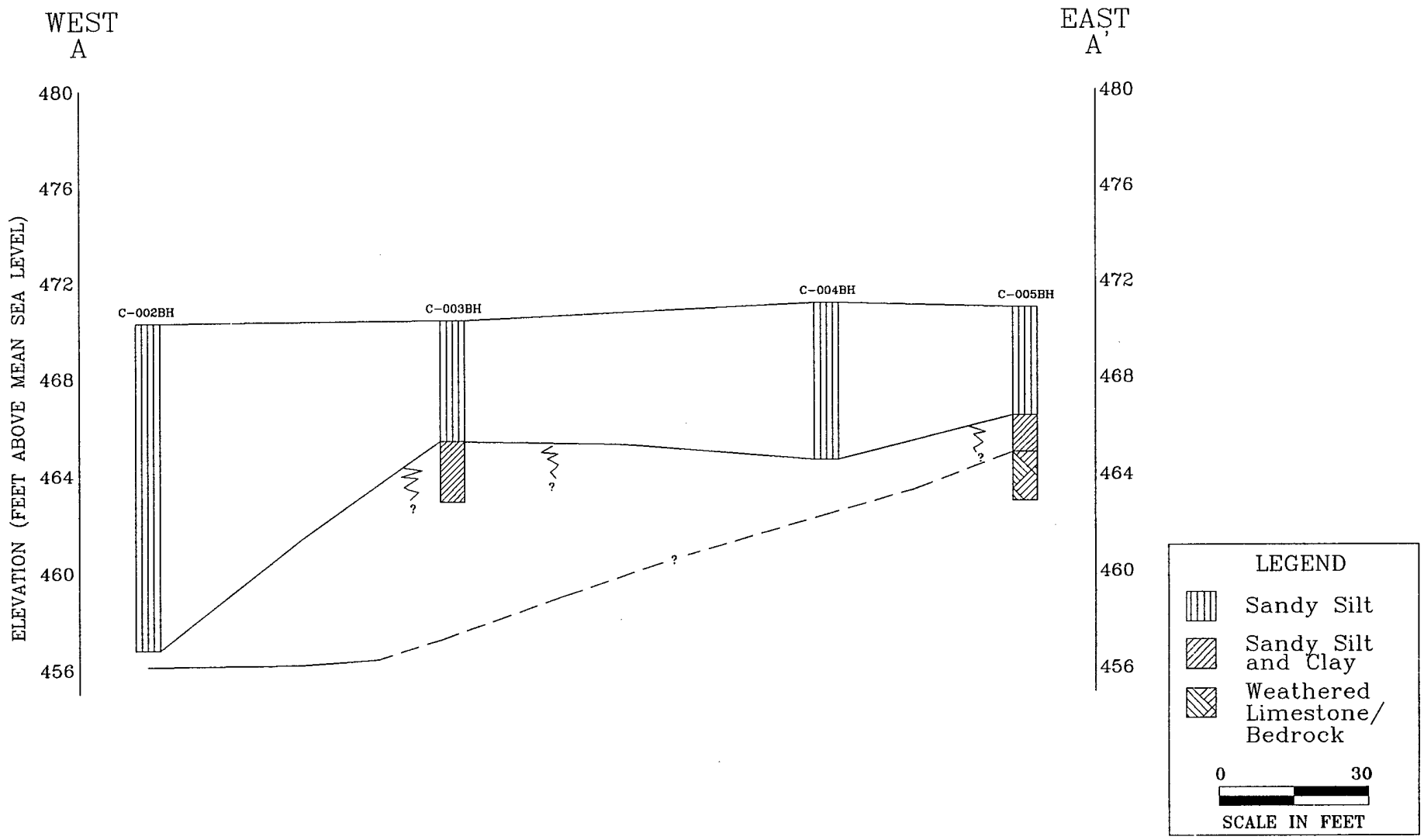

FIGURE 6.14

JEFF\CROS-C

GEOLOGIC CROSS-SECTION OF DRAINAGE DITCH AOC (AOC C)

157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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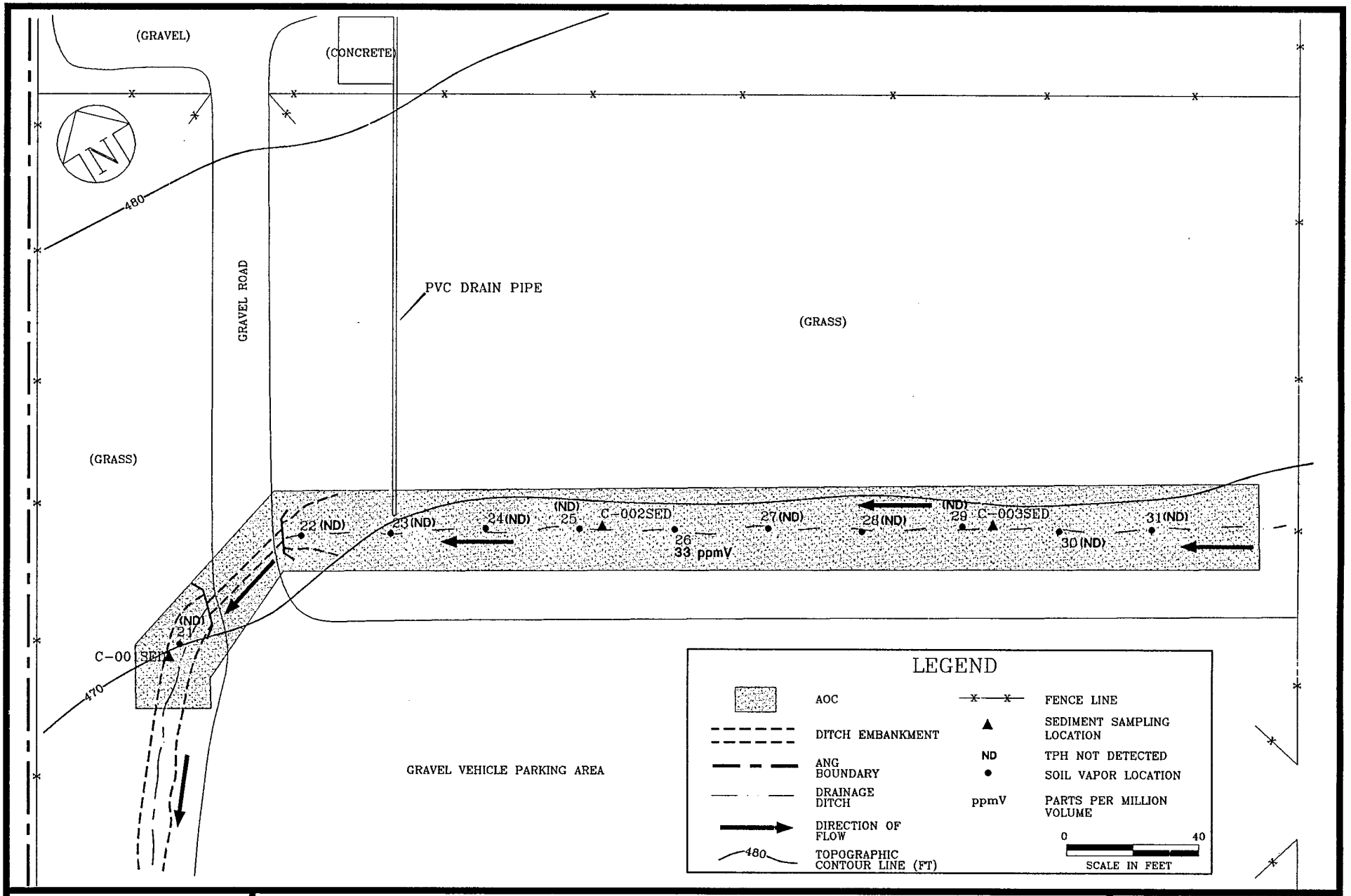

FIGURE 6.15

JEFF\INSPEC-C

TPH DETECTED DURING SOIL GAS SURVEY AT DRAINAGE DITCH AOC (AOC C)

157th ACG, Jefferson Barracks ANGS

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eight samples, ranging from 2 to 43 ppb (Figure 6.17). PCE was detected in the four samples collected from boring C-002BH, ranging from 107 to 549 ppb (Figure 6.18). The low concentrations did not indicate widespread contamination was detected through field screening at this AOC, and all but one sample screened was submitted for laboratory analysis. Complete field GC chromatograms and results are presented in Appendix D.

6.5.2 Analytical Results

Table 6.7 lists the intervals where the soil samples were obtained that were submitted for laboratory analysis. A total of 10 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and metals. There were no VOC, SVOC, or TPH compounds detected in soil samples submitted from this AOC. Again, the confidence level for accuracy of the laboratory analyses is significantly higher than for field screening instruments. Additionally, the laboratory USEPA quantification limit for the VOCs detected ranged from 11 to 14 ppb, which was higher than the detection limit of 1 ppb for the field GC; therefore, true VOC concentrations in soil samples less than the laboratory USEPA method quantification limit would not be detected.

Table 6.7
AOC-C Drilling Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drilling Location/ Borehole Identification	Interval Submitted for Laboratory analysis (Feet BLS)
C-001BH	
INT-1	0.5 - 2.0
C-002BH	
INT-1	0.5 - 2.0
INT-2	5.0 - 6.5
INT-3	11.5 - 13.0
C-003BH	
INT-1	0.5 - 2.0
INT-2	5.0 - 6.5
C-004BH	
INT-1	0.5 - 2.0
INT-2	5.0 - 6.5
C-005BH	
INT-1	0.5 - 2.0
INT-2	4.5 - 6.0

AOC – Area of concern. INT – Interval.
BLS – Below Land Surface.

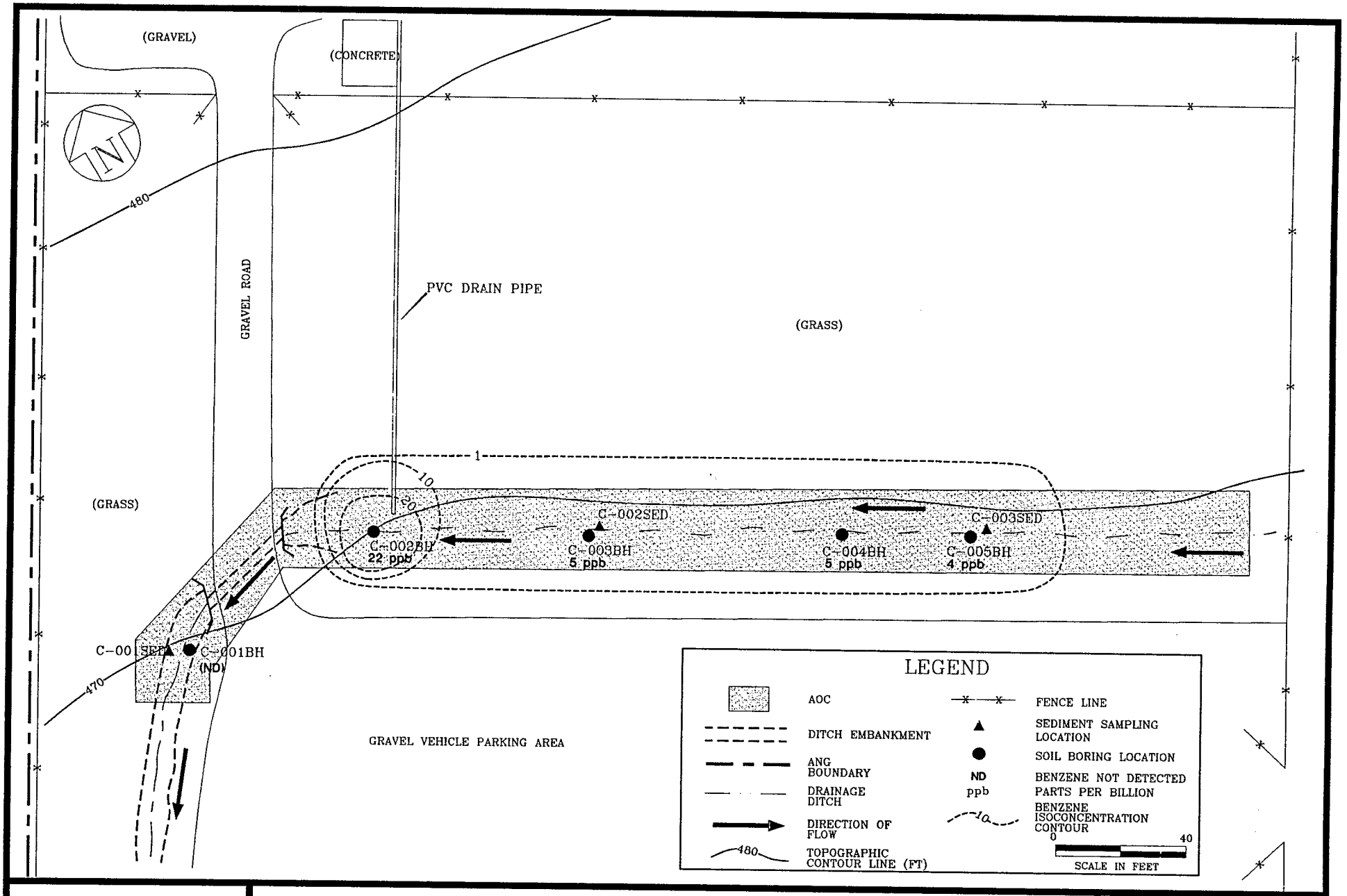

FIGURE 6.16

JEFF\INSPEC-C

BENZENE DETECTED IN FIELD GC SCREENING
AT DRAINAGE DITCH AOC (AOC C)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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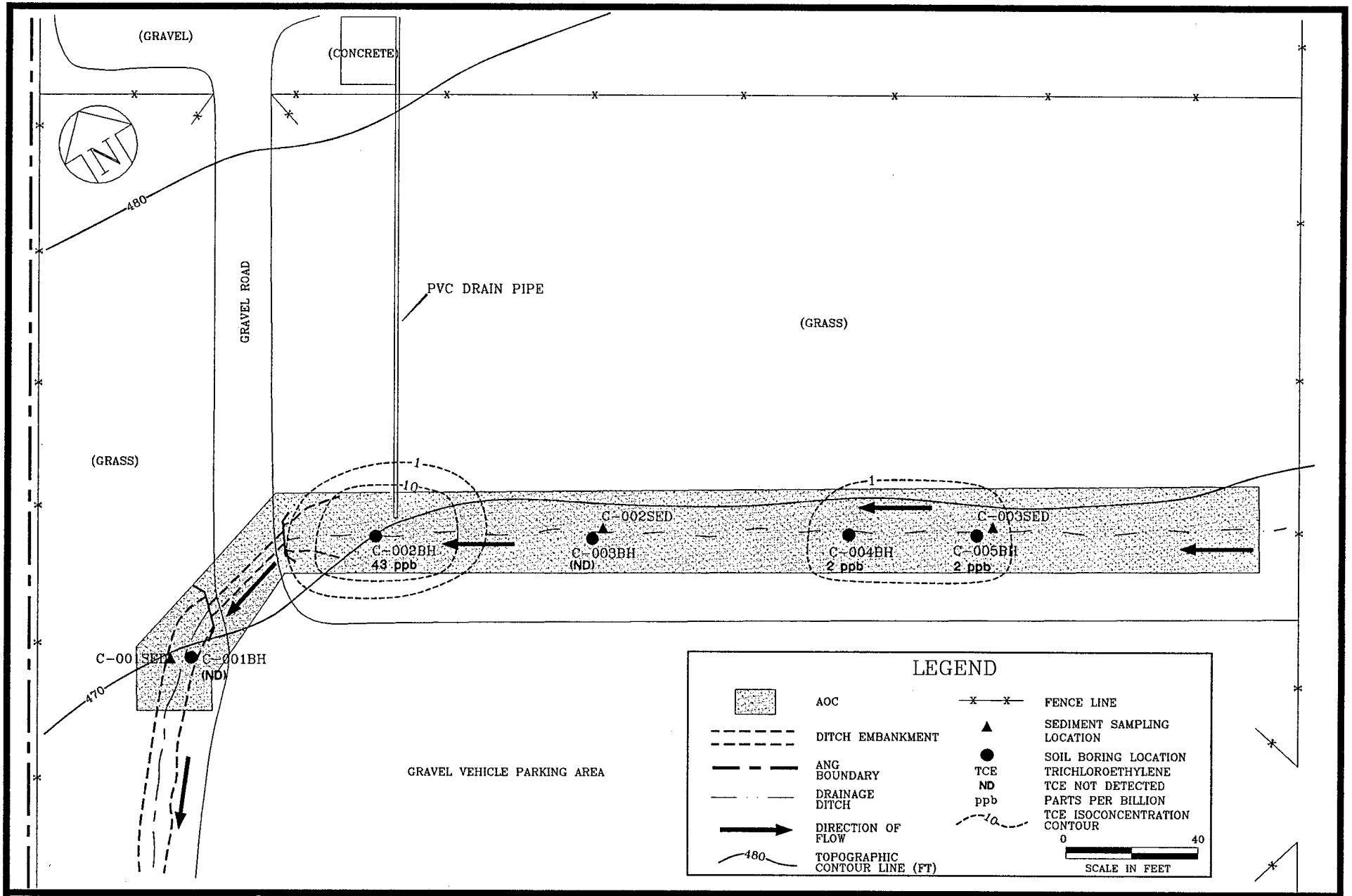

FIGURE 6.17

JEFF\INSPEC-C

TCE DETECTED IN FIELD GC SCREENING
AT DRAINAGE DITCH AOC (AOC C)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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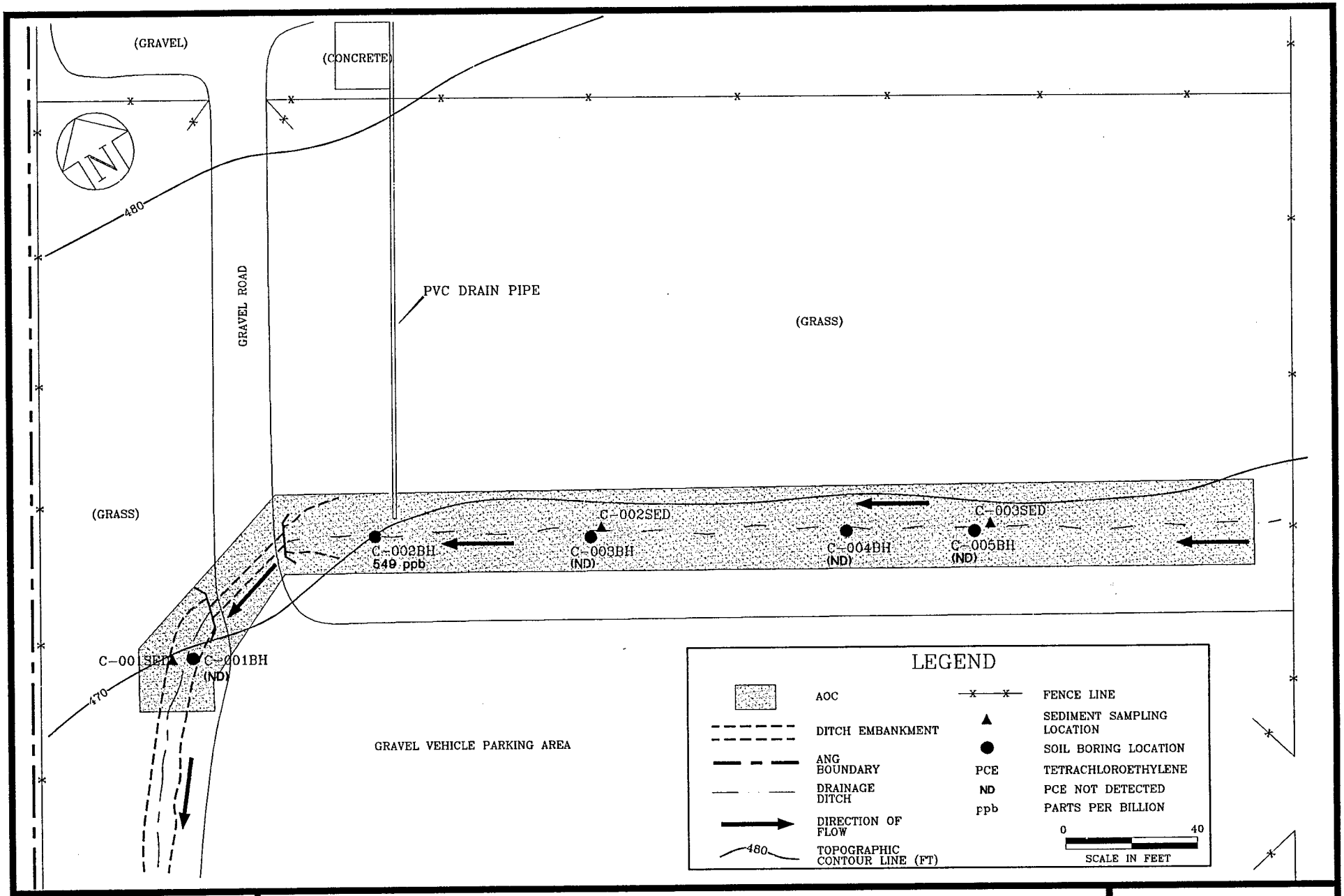

FIGURE 6.18

JEFF\INSPEC-C

PCE DETECTED IN FIELD GC SCREENING
AT DRAINAGE DITCH AOC (AOC C)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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Metals concentrations detected in soil samples from AOC-C are listed in Table 6.8 and are presented on Figure 6.19. Mercury, selenium, and thallium were not detected in concentrations above method reporting limits. Antimony concentrations ranged from 6.6 to 14 μg/kg, arsenic ranged from 2.8 to 7.7 mg/kg, beryllium ranged from 0.30 to 2.8 mg/kg, cadmium ranged from non-detect to 2.1 mg/kg, chromium ranged from 11.9 to 75.3 mg/kg, copper ranged from 11.3 to 143 mg/kg, lead ranged from 12.2 to 44.3 mg/kg, nickel ranged from 17.1 to 122 mg/kg, silver was detected in one sample at 11.0 μg/kg, and zinc ranged from 32.3 to 141 mg/kg.

Three surface sediment samples were collected at this AOC for laboratory analysis for VOCs, SVOCs, TPH, and metals. Samples were collected as discussed in Subsection 5.3.2. There were no VOCs, SVOC, or TPH compounds detected in surface sediment soil samples (Figure 6.19).

Metals concentrations detected in sediment samples from AOC-C are listed in Table 6.9. Mercury, selenium, silver and thallium were not detected in concentrations above method reporting limits. Antimony was detected in one sample at 10.3 μg/kg, arsenic concentrations ranged from 4.6 to 5.3 mg/kg, beryllium ranged from non-detect to 0.64 mg/kg, cadmium ranged from 0.99 to 7.5 mg/kg, chromium ranged from 17.8 to 49.7 mg/kg, copper ranged from 15.1 to 46.6 mg/kg, lead ranged from 68 to 281 mg/kg, nickel ranged from 16 to 19 mg/kg, and zinc ranged from 66 to 471 mg/kg.

6.6 WASTE OIL DUMP AOC (AOC-D)

AOC-D is located approximately 50 feet south of Building 55 and is immediately west of the Hazardous Materials Storage Area (see Figure 6.20). The surface is grass and gravel covered and measures approximately 15 feet by 15 feet. Visual evidence of the hole where waste products were disposed is no longer discernable; however, gravel fill material indicates the apparent location of where the hole existed.

A geophysical survey, soil gas survey, and soil borings were used to evaluate physical and environmental conditions, confirm or deny contamination, and to characterize the subsurface geology and soil properties at the AOC. The geophysical survey indicated no subsurface structures or drilling hazards at the AOC, and no problems were encountered during drilling. The two soil boring locations for AOC-D are shown on Figure 6.5. Soil boring D-001BH was located in the middle of the AOC where the shallow hole, where used motor oil was reportedly disposed, is believed to be located. Although the Work Plan stipulated that only one boring would be drilled at AOC-D to investigate the area of the hole reportedly used for waste oil

Table 6.8
AOC-C Metals Analyses Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metals	C-001BH 0.5 - 2.0 (Ft BLS)	C-002BH 0.5 - 2.0 (Ft BLS)	C-002BH 5.0 - 6.5 (Ft BLS)	C-002BH 11.5 - 13.0 (Ft BLS)	C-003BH 0.5 - 2.0 (Ft BLS)	C-003BH 5.0 - 6.5 (Ft BLS)	C-004H 0.5 - 2.0 (Ft BLS)	C-004H 5.0 - 6.5 (Ft BLS)	C-005H 0.5 - 2.0 (Ft BLS)	C-005BH 4.5 - 6.0 (Ft BLS)
Antimony	8.6	4.2U	4.1U	5.2B	4.0U	4.4U	4.2U	6.6	4.2U	14
Arsenic	5.5	6.3	3.5	2.9	7.7	4.7	3.5	3.0	2.8	6.6
Beryllium	0.30B	0.80	0.60	0.76	0.68	0.63	0.71	1.7	0.83	2.8
Cadmium	0.93	0.22U	0.22U	0.22U	0.21U	0.23U	0.22U	0.40B	0.22U	2.1
Chromium	15.7	29.3	11.9	23.5	19.5	14.6	16.6	33.1	19	75.3
Copper	13.4	20.4	19.8	15.1	33.1	21.1	143	19.8	11.3	26.4
Lead	44.3	14	13	12.2	17.7	13.7	14.5	18.3	14.8	34.7
Nickel	22.5	22.2	17.1	19.9	23.3	17.4	18	41.5	19.2	122
Silver	0.59U	0.55U	0.54U	0.55U	0.53U	0.57U	11	0.46U	0.55U	0.59U
Zinc	84.1	58.3	42.8	64.1	91.3	37.9	103	44	32.3	141

AOC – Area of Concern.
BH – Borehole.
BLS – Below Land Surface.
Ft – Feet.

U – Indicates compound was analyzed for but was not detected.
B – Sample value range greater than the instrument detection limit, but less than the reporting limit.

Note: All analyte concentrations expressed in milligrams per kilogram (mg/kg). Analytical Methods: SW6010 with the exception of arsenic (SW7060), and lead (SW7421).

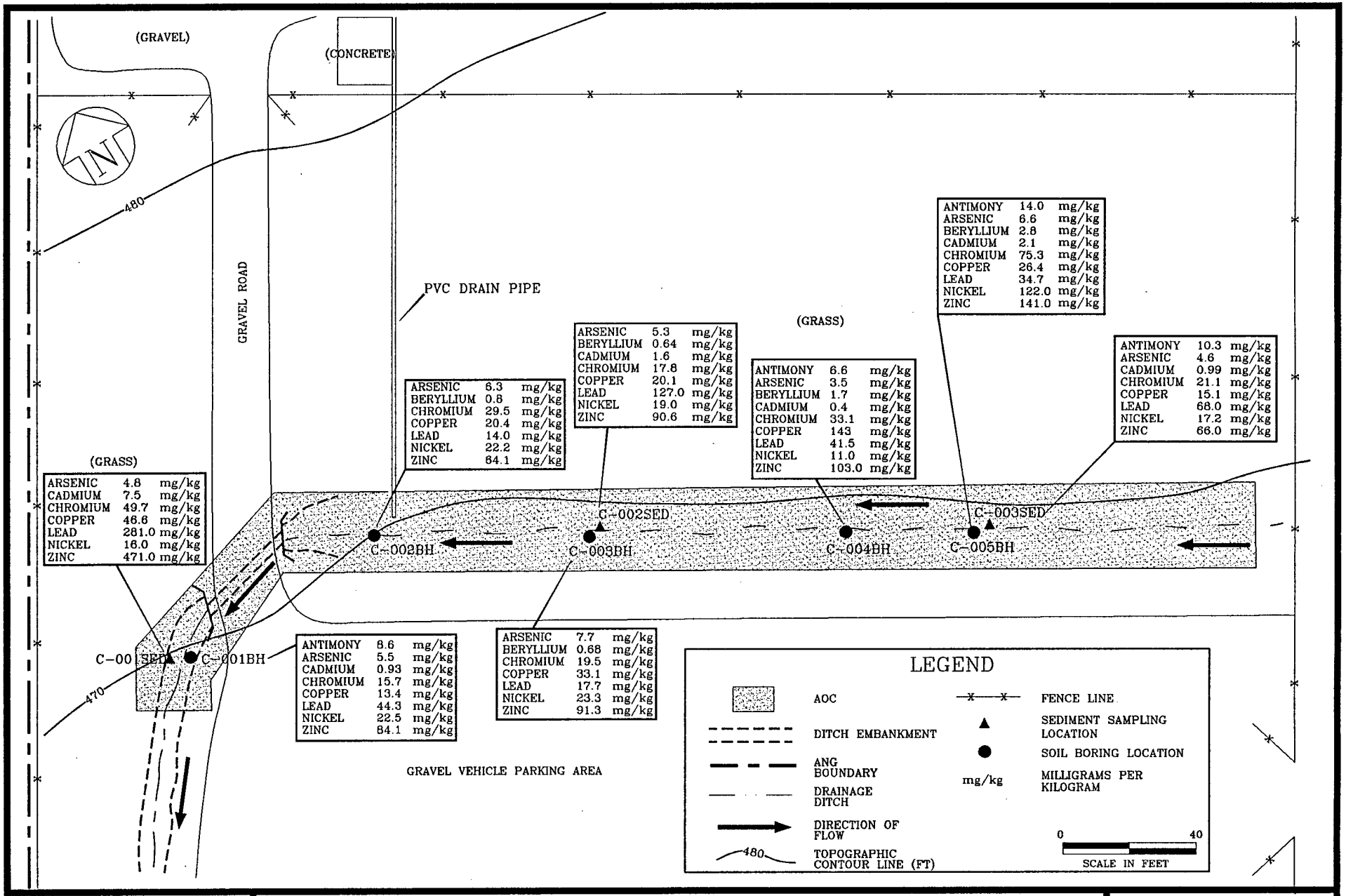

FIGURE 6.19

JEFF\INSPEC-C

RESULTS OF LABORATORY ANALYSIS AT DRAINAGE DITCH AOC (AOC C)

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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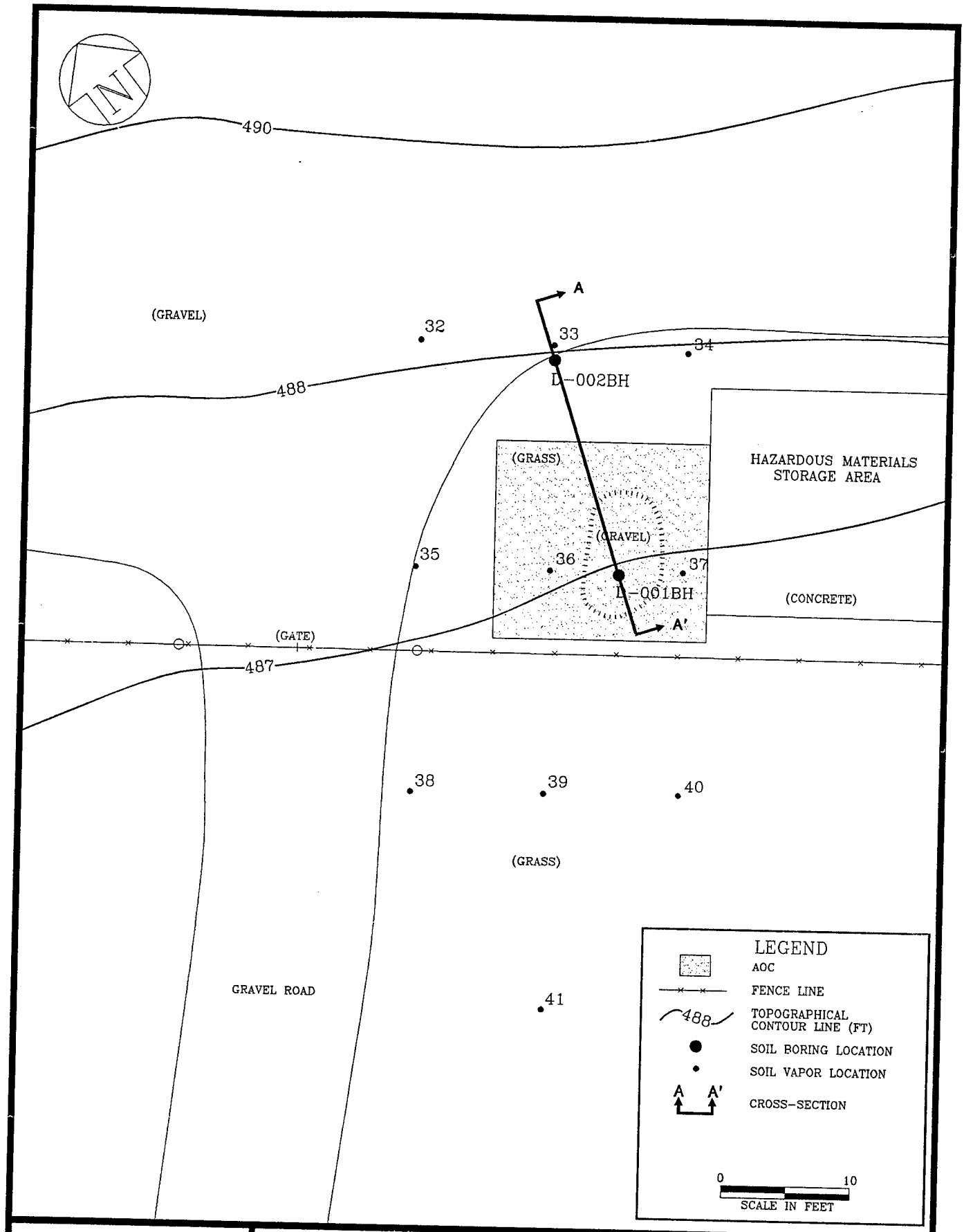

FIGURE 6.20

JEFF\INSPEC-D

INSPECTION ACTIVITIES AT
WASTE OIL DUMP AOC (AOC D)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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Table 6.9
AOC-C Surface Sediment Metals Analyses Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metals	C-001 SED	C-002 SED	C-003 SED
Antimony	5.5U	4.4U	10.3
Arsenic	4.8	5.3	4.6
Beryllium	0.29U	0.64	0.49B
Cadmium	7.5	1.6	0.99
Chromium	49.7	17.8	21.1
Copper	46.6	20.1	15.1
Lead	281	127	68
Nickel	16	19	17.2
Zinc	471	90.6	66

AOC – Area of Concern.
SED – Sediment.
U – Indicates compound was analyzed for but was not detected.
B – Sample value range greater than the instrument detection limit, but less than the reporting limit.

Note: All analyte concentrations expressed in milligrams per kilogram (mg/kg). Analytical Methods: SW6010 with the exception of arsenic (SW7060), and lead (SW7421).

disposal, boring D-002BH was added and drilled at the SGS-33 location to obtain soil samples for laboratory analysis because of the high TPH soil gas reading at that location.

Boring D-001BH was drilled to a total depth of 26.8 feet BLS, where bedrock was encountered. Boring D-002BH was drilled to a total depth of 22.8 feet BLS, where bedrock was encountered. Groundwater was not observed at either boring location prior to borehole abandonment. Three soil samples were collected from each boring for laboratory analysis. Gravel fill material was observed at this AOC from the land surface to approximately 9.0 feet BLS. The first soil sample was not obtained until a soil matrix was encountered below the gravel fill. A geologic cross-section of AOC-D is presented in Figure 6.21.

6.6.1 Field Screening Results

A soil gas survey was conducted at the AOC to screen for BTEX and TPH contamination associated with possible contamination from waste oil disposal. The locations of these soil gas sampling points are shown in Figure 6.20. A total of 10 sampling points were arranged to cover the extent of the AOC. The soil gas sample was collected from a depth of 5.0 feet BLS using procedures outlined in Subsection 5.2.2.1.

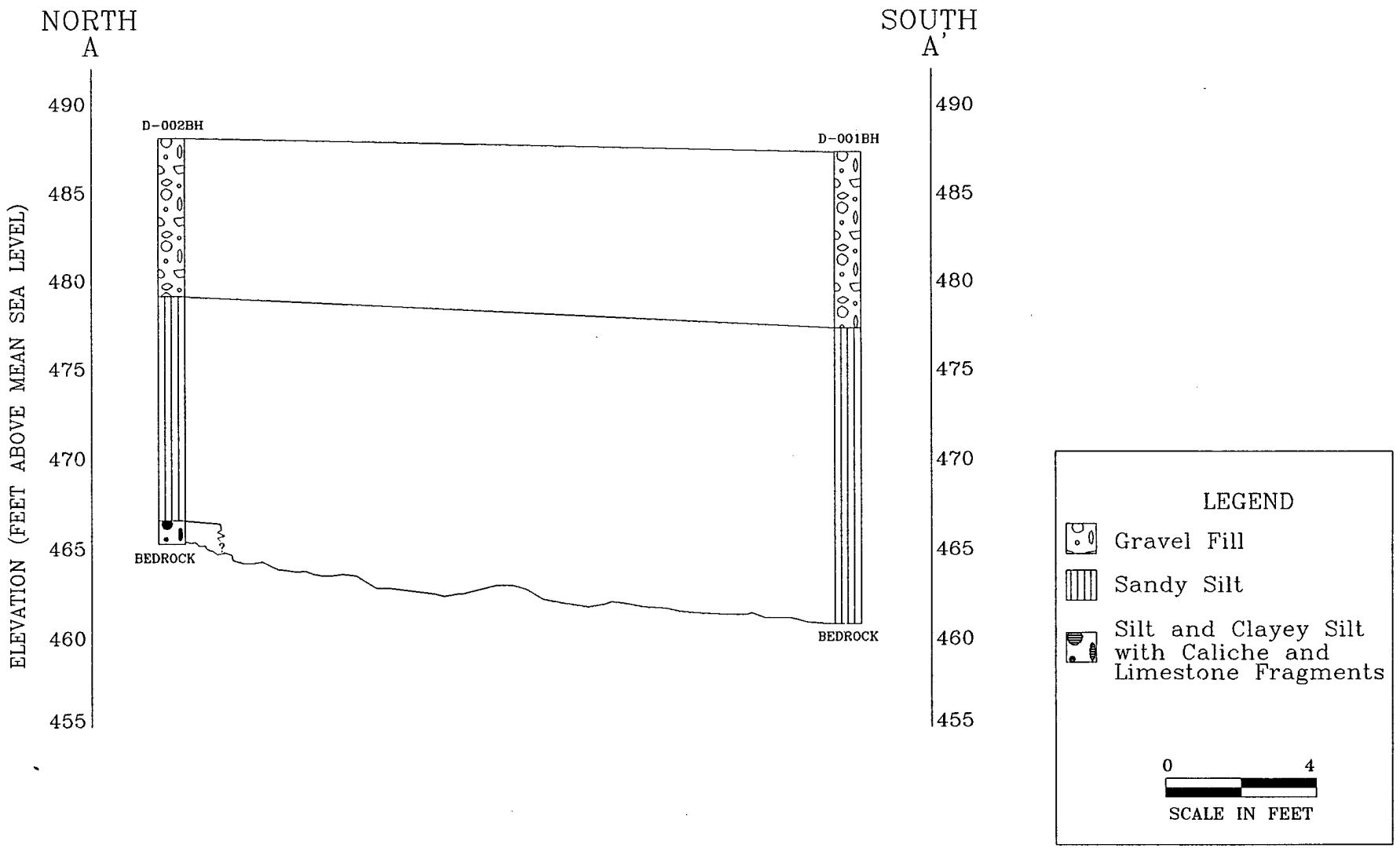

FIGURE 6.21

JEFF\CROS-D

GEOLOGIC-CROSS SECTION OF WASTE OIL DUMP AOC (AOC D)

157th ACG Jefferson Barracks ANGS
St. Louis, Missouri

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TPH were detected in four soil gas samples from this AOC. TPH were detected at SGS-33, SGS-34, SGS-36, and SGS-38 at 2,202, 37, 244, and 13 ppmV, respectively, and are shown on Figure 6.22. These values, covering the range C1 through C9, indicated a concentration expressed as hexane. No BTEX was detected in any soil gas samples from this AOC. Complete soil gas survey data is presented in Appendix B. Soil boring D-002BH was added to the AOC and located at the SGS-33 location to provide soil samples for laboratory analysis from the area where the highest TPH results were obtained. Boring D-001BH was located in the center of the AOC near SGS-36 where the second highest TPH readings were detected at the AOC, and where the shallow hole in the ground surface was believed to be located.

A total of six soil samples were screened for BTEX, DCE, TCE, and PCE with the field GC as outlined in Subsection 5.2.2.3. Toluene was detected in two samples at 1 and 2 ppb. Ethylbenzene and xylene were detected in one sample at 9 and 15 ppb, respectively. TCE was detected in two samples at 1 and 7 ppb, and PCE was detected in one sample at 2 ppb. The low concentrations did not indicate that widespread contamination was detected through field screening at this AOC. Complete field GC chromatograms and results are presented in Appendix D.

6.6.2 Analytical Results

Table 6.10 lists the intervals where soil samples from AOC-D were obtained that were submitted for laboratory analysis.

Table 6.10
AOC-D Drilling Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Drilling Location/ Borehole Identification	Interval Submitted for Laboratory Analysis (Feet BLS)
D-001BH	
INT-1	10.0 - 11.5
INT-2	15.0 - 16.5
INT-3	25.0 - 26.5
D-002BH	
INT-1	9.0 - 10.5
INT-2	15.0 - 16.5
INT-3	21.5 - 23.0

AOC – Area of concern. INT – Interval.
BLS – Below Land Surface.

A total of six soil samples were submitted for laboratory analysis for SVOCs, TPH, and metals. There were no SVOC or TPH compounds detected in soil from any sample submitted from this

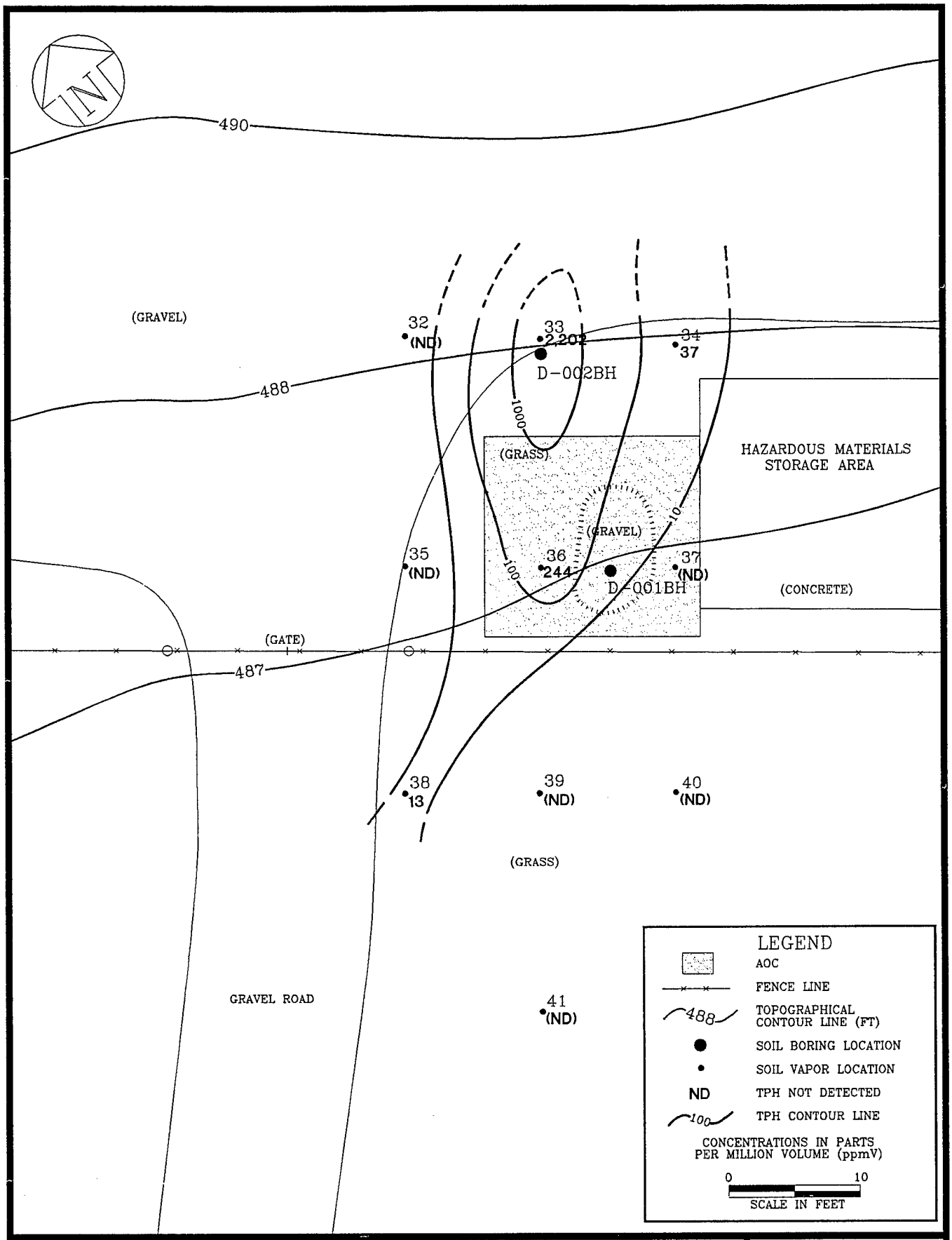

FIGURE 6.22

JEFF\INSPEC-D

TPH DETECTED DURING SOIL GAS SURVEY AT WASTE OIL DUMP AOC (AOC D)
157th ACG, Jefferson Barracks ANGS
St. Louis, Missouri

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AOC. Laboratory analyses for SVOCs and TPH did not include hydrocarbons in this range. BTEX and solvent compounds detected by field GC screening of soil samples ranged from 2 to 15 ppb, concentrations that are not considered harmful to human health and the environment.

The analytical range for TPH by Method 8015 (low- and high-boiling point hydrocarbons) detects hydrocarbons with carbon ranges from C2 to approximately C31, effectively covering the same range as the soil gas survey analyses with the exception of C1, methane. Field GC analysis did not indicate lighter hydrocarbons (VOCS) at concentrations greater than 15 ppb. Therefore, the non-detection of TPH by laboratory analysis and VOCs with the field GC indicates a possible methane detection by soil gas survey TPH results.

Metals concentrations detected in soil samples from AOC-D are listed in Table 6.11 and presented on Figure 6.23. Antimony, cadmium, mercury, selenium, silver and thallium were not detected in concentrations above method reporting limits. Arsenic concentrations ranged from 4.2 to 9.8 mg/kg, beryllium ranged from 0.59 to 1.9 mg/kg, chromium ranged from 13 to 55.8 mg/kg, copper ranged from 15.3 to 49.8 mg/kg, lead ranged from 10.9 to 34.6 mg/kg, nickel ranged from 15.8 to 51.9 mg/kg, and zinc ranged from 49.7 to 127 mg/kg.

Table 6.11
AOC-D Metals Analyses Summary Table
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metals	D-001BH 10.0 - 11.5 (Ft BLS)	D-001BH 15.0 - 16.5 (Ft BLS)	D-001BH 25.0 - 26.5 (Ft BLS)	D-002BH 9.0 - 10.5 (Ft BLS)	D-002BH 15.0 - 16.5 (Ft BLS)	D-002BH 21.5 - 23.0 (Ft BLS)
Arsenic	5.9	4.2	9.8	7.5	4.7	7.6
Beryllium	0.59B	0.62	1.9	0.73	0.63	1.5
Cadmium	0.24U	0.23U	0.70B	0.31B	0.45B	0.31B
Chromium	19.6	13	49.9	21.8	15	55.8
Copper	15.3	49.4	49.8	22.4	28.8	30.3
Lead	23.9	17.0	34.6	17.3	10.9	23.7
Nickel	15.8	19.3	51.9	19.5	17.9	47.6
Zinc	49.7	87.4	127	58.0	60.5	90.1

U – Indicates compound was analyzed for but was not detected.
B – Sample value range greater than the instrument detection limit, but less than the reporting limit.
AOC – Area of Concern.
BH – Borehole.
BLS – Below Land Surface.
Ft – Feet.
Note: All analyte concentrations expressed in milligrams per kilogram (mg/kg). Analytical Methods: SW6010 with the exception of arsenic (SW7060), and lead (SW7421).

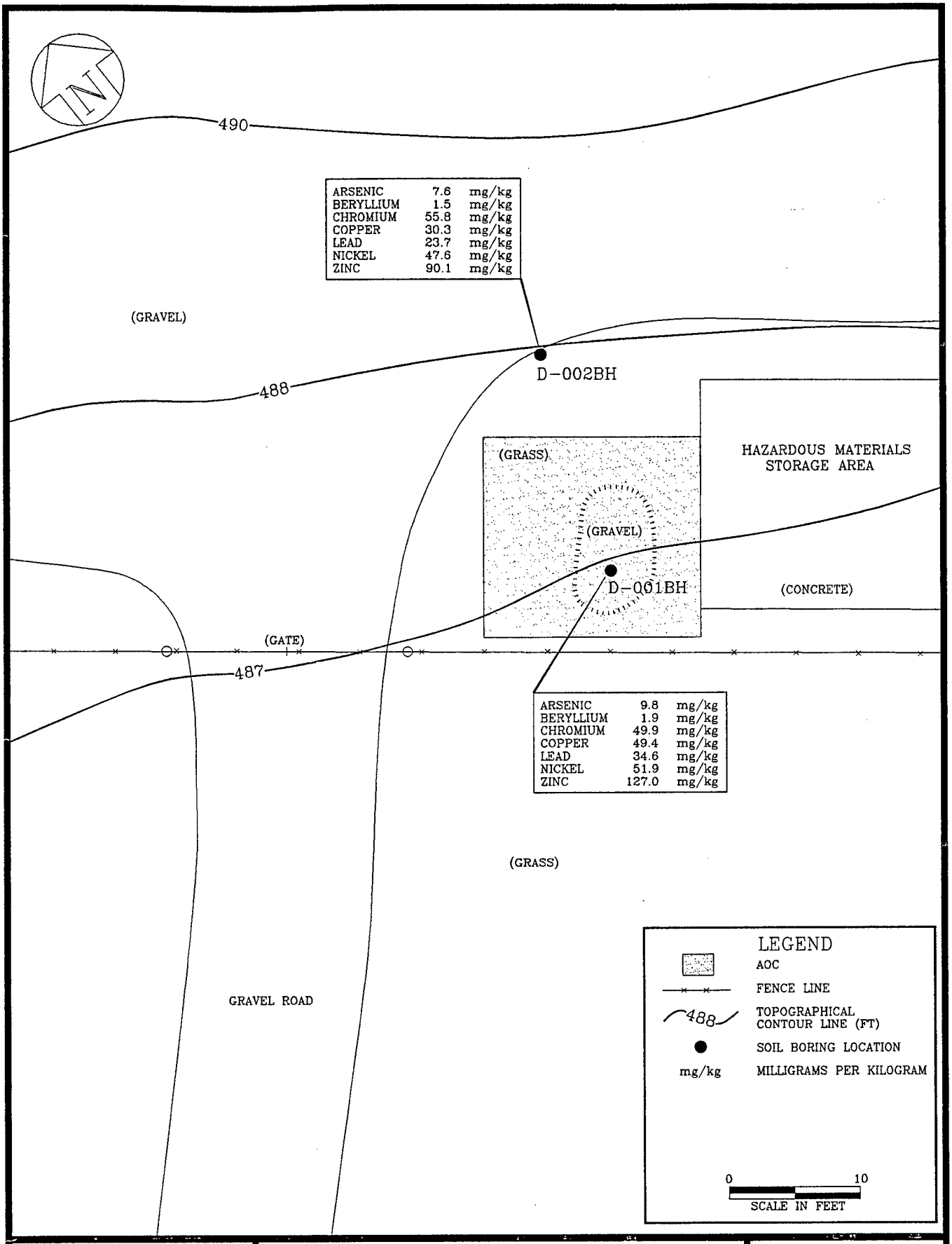

FIGURE 6.23

JEFF\INSPEC-D

RESULTS OF LABORATORY ANALYSES AT WASTE OIL DUMP AOC (AOC D)

157th ACG, Jefferson Barracks ANGS

St. Louis, Missouri

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SECTION 7.0 CONCLUSIONS

7.1 SUMMARY

ANGRC/CEVR authorized OpTech to prepare a PA/SI Work Plan and conduct SI activities at the 157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri. The PA was initiated by ANGRC and OpTech personnel in November 1993, during which four AOCs were identified for further investigation based on past waste handling and disposal practices. Field SI activities were conducted as outlined in the PA/SI Work Plan submitted to ANGRC in October 1994. The SI at the 157th ACG commenced on 5 December 1994 and was completed on 15 December 1994.

The field work at the 157th ACG was accomplished by completing the following tasks:

- Conducting a soil gas survey at the four AOCs that included a total of 41 sampling points that screened soil gas for BTEX and TPH;
- Conducting a geophysical survey at AOC-A and AOC-D to verify no subsurface structures or hazards to drilling were present, based on historical information obtained during the PA;
- Drilling a total of 14 soil borings at the four AOCs to obtain soil for field screening, subsurface geological characterization, and laboratory analysis;
- Submitting a total of 37 soil samples and three surface sediment samples for AOC-specific analytical programs that included analysis of VOCs, SVOCs, TPH, and metals; and
- Surveying the location of all soil gas points and the location and elevation of all soil borings.

The evaluation of analytical results obtained from soil samples collected from the four AOCs usually entails comparisons to applicable, relevant, and appropriate requirements (ARARs). However, the MDNR has not established state action levels or cleanup standards for many analytes detected during this inspection; the MDNR negotiates cleanup levels for those contaminants on a case-by-case basis.

MDNR recommends comparing BTEX and TPH against cleanup levels outlined in the Missouri Site Characterization Guidance Document (MDNR, 1991). At Jefferson Barracks ANGS, VOCs were not detected in soil from any sample submitted for laboratory analysis from AOC-B and AOC-C; samples collected from AOC-A and AOC-D were not analyzed for VOCs. The trace concentrations of VOCs detected by the field GC screening process at AOC-A and AOC-D do not constitute a threat to human health or the environment.

TPH were detected in soil in three samples from AOC-B. However, when compared to criteria of the Missouri UST Closure Guidance Document (MDNR, 1996a), all TPH concentrations, with the exception of one, were below calculated site-specific soil cleanup guidelines of 200 ppm. The one sample that exceeded cleanup guidelines was from B-001BH (3.5-5.0) that indicated TPH as #2 Fuel Oil at 440 ppm. The sample interval submitted for laboratory analysis following B-001BH (3.5-5.0) was B-001BH (10.0-11.5), and TPH were not detected in that sample. TPH as #2 Fuel Oil were detected in B-001BH (30.0-31.5) at 100 mg/kg, below soil cleanup guidelines. The site rating criteria is provided in Table 7.1.

SVOCs were detected in two soil samples from AOC-B. The SVOCs detected were PAHs, and concentrations ranged from 240 to 2,500 μg/kg. MDNR has not established action levels for PAH contamination and determines cleanup requirements on a case-by-case basis. The two samples where PAH contamination was detected occurred in the surface sample intervals from approximately 0.5 to 2.0 feet BLS. No SVOCs were detected in soil from the next sampling intervals at those locations, which were from approximately 5.0 and 10.0 feet BLS. Therefore, SVOC contamination at the AOC appears to occur in shallow, localized areas.

Metals were detected in various concentrations at the four AOCs. Metals concentrations were compared with data from a USGS Report (Shacklette and Boerngen, 1984) that describes naturally occurring metals concentrations in soils in the conterminous United States and from a subsequent USGS Report (Tidball, 1984) dealing with the geochemical aspects of Missouri soils. Tidball's study found that the average metals concentrations cited by the Shacklette and Boergen report are remarkably close. The Shacklette and Boergen report values are used in the analysis of this investigation. Tidball summarizes that the soils of Missouri tend to have slightly larger amounts of the SI target metals for chromium, lead and zinc.

Table 7.2 lists the average and maximum metals concentrations for all 40 samples analyzed for metals. Five metals slightly exceeded the range of background concentrations in soil from at least one sample. However, this may indicate elevated levels of naturally occurring background

Table 7.1
Missouri LUST Soil Cleanup Guidelines for Undisturbed Soil
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Site Features	Score 15 if True		Score 10 if True		Score 5 if True		Score 0 if True	
Depth to groundwater?	>100 ft.		100-51 ft.		50-25 ft.		<25 ft.	0
Groundwater potable?	No	15					Yes	
Drinking water supply proximity?	>1,000 ft. away	15	1,000-501 ft. away		500-100 ft. away		<100 ft. away	
Distance to surface waters?	>5,000 ft.		5,000-2,501 ft.		2,500-1,000 ft.	5	<1,000 ft.	
Geologic features present?	>2,000 ft.		2,000-1,001 ft.		1,000-500 ft.		<500 ft.	0
Man-made vertical conduits?	>500 ft.	15	500-251 ft.		250-100 ft.		<100 ft.	
Man-made horizontal conduits?	>250 ft.		250-101 ft.		100-50 ft.		<50 ft.	0
Soil permeability? (see definitions)	Low	15	Low-Moderate		Moderate-High		High	
Soil thickness? (see overburden map)	>50 ft.		50-41 ft.		40-20 ft.	5	<20 ft.	
Environmentally sensitive receptors	>5,000 ft.		5,000-2,501 ft.		2,500-1,000 ft.	5	<1,000 ft.	
Surrounding land use?	>1,000 ft. away		1,000-501 ft. away	10	500-100ft. away		<100 ft. away	
Future land use?	Industrial	15	Commercial				Residential	
Off-site impact?	No	15					Yes	
Subtotals		90		10		15		0
						Total Score =		**115**

Soil Cleanup Levels (ppm)					
Total Score	195-150	149-120	119-80	79-50	49 or less
BTEX	4/20/100/100	2/10/50/50	1/5/10/10	0.5/1/2/2	B+T+E+X <2
TPH	1000	500	200	100	50

Ft. – Feet.
ppm – Part per million.
TPH – Total petroleum hydrocarbons.
BTEX – Benzene, toluene, ethylbenzene, and Xylene.

Source – Missouri Department of Natural Resources Underbround Storage Tank Closure Guidance Document, March 1996.

conditions, since the metals identified were not considered potential contaminants based on historical activities identified in the PA.

7.2 AOC-SPECIFIC CONCLUSIONS

7.2.1 Disposal Area AOC (AOC-A)

A total of nine soil samples were submitted for laboratory analysis for SVOCs, TPH, and metals. One SVOC, bis(2-ethylhexyl)phthalate, was detected at 720 μg/kg in one sample.

Table 7.2
Comparison of Metals Detected in Soil and Sediment Samples at the AOCs to Naturally-Occurring Concentrations of Metals in East-Central Missouri
157th ACG, Jefferson Barracks ANGS, St. Louis, Missouri

Metal	Number of Detects in 40 Samples	Detected Concentrations at the station (mg/kg)		Range of Naturally-Occurring Concentrations in Soils for East-Central Missouri†	Samples Exceeding Background Concentrations
		Avg.	Max.		
Antimony	4	9.8	14	1 - 10	2
Arsenic	40	5.6	10.7	2.6 - 13.5	0
Beryllium	23	0.85	2.8	1 - 3	0
Cadmium	9	2.0	7.5	1 - 11	-
Chromium	40	23.4	75.3	20 - 70	1
Copper	40	29.2	143	20 - 50	3
Lead	40	37.6	281	15 - 700	0
Nickel	40	24.6	122	25 - 80	5
Silver	1	11.0	11.0	Not Available	-
Zinc	40	107.4	710	28 - 120	10

mg/kg – milligrams per kilogram.
† – Source: Shacklette and Boerngen, 1984.
Not Available – No data available for this analyte.
Avg. – Average.
Max. – Maximum.

However, this was attributed to laboratory-induced contamination (USEPA, 1993). Metals concentrations detected at AOC-A were all within naturally occurring background levels in soil (Shacklette and Boerngen, 1984). TPH were not detected in any sample from this AOC. The trace concentrations of VOCs detected by the field screening process at AOC-A do not constitute a threat to human health or the environment and therefore do not warrant further investigation.

7.2.2 Storage Area AOC (AOC-B)

A total of 12 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and metals. SVOCs were detected in two soil samples from this AOC. The SVOCs detected were

PAHs; concentrations ranged from 240 to 2,500 μg/kg and are believed to indicate surficial to very shallow, localized areas of contamination. MDNR has not established action levels for PAH contamination and determines cleanup requirements on a case-by-case basis. The two samples where PAH contamination was detected occurred in the surface sample interval: B-003BH (1.0-2.5) and B-004BH (0.5-2.0). The second sample interval analyzed from these locations, B-003BH (5.0-6.5) and B-004BH (10.0-11.5), contained no detectable concentrations of PAH compounds, therefore indicating a limited areal extent of contamination.

Minute amounts of VOCS were detected in soil by field GC screening, but these results were not confirmed by laboratory analyses.

TPH were detected at AOC-B at a maximum concentration of 440 mg/kg in soil from B-001BH (3.5-5.0). Using Table 10 in the Missouri Site Characterization Guidance Document (MDNR, 1991), the soil cleanup guidelines for leaking USTs is 200 ppm. Soil from this boring interval exceeded these soil cleanup guidelines.

Metals concentrations detected at AOC-B were all within naturally-occurring background levels in soils (Shacklette and Boerngen, 1984) except for copper, nickel and zinc. These three metals slightly exceeded background range values and may reflect elevated natural background conditions since historical activities at the site do not include copper, nickel or zinc as potential contaminants.

Inspection results indicated TPH exceeded MDNR cleanup standards for leaking USTs in one sample from B-001BH. Since this boring was drilled in the northeast portion of the site, and the next investigative sample from that boring was obtained from 10.0-11.5 feet BLS, the vertical and areal extent of TPH has not been defined.

7.2.3 Drainage Ditch AOC (AOC-C)

A total of 10 soil samples were submitted for laboratory analysis for VOCs, SVOCs, TPH, and metals. Five metals detected at AOC-C exceeded the typical range for naturally occurring background levels in soils (Shacklette and Boerngen, 1984). These metals (antimony, chromium, copper, nickel, and zinc) may represent slightly elevated natural background levels. VOCs, SVOCs, and TPH were not detected in soil or sediments from any sample at this AOC.

Minute amounts of VOCS were detected in soil by field GC screening, but these results were not confirmed by laboratory analyses.

7.2.4 Waste Oil Dump AOC (AOC-D)

A total of six soil samples were submitted for laboratory analysis for SVOC, TPH, and metals. Metals concentrations detected at AOC-D were all within naturally occurring background levels in soils (Shacklette and Boerngen, 1984) except for nickel and zinc. These two metals slightly exceeded background range values and may reflect slightly elevated natural background conditions since historical activities at the site do not include nickel and zinc as potential contaminants. SVOCs and TPH were not detected in soil from any sample at this AOC. The trace concentrations of VOCs detected by the field screening process at AOC-D do not constitute a threat to human health or the environment and therefore do not warrant further investigation.

SECTION 8.0 RECOMMENDATIONS

8.1 AOC-SPECIFIC RECOMMENDATIONS

8.1.1 Disposal Area AOC (AOC-A)

Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-A.

8.1.2 Storage Area AOC (AOC-B)

The vertical and areal extent of TPH at AOC-B has not been delineated. In order to characterize the vertical and areal extent of TPH contamination in excess of MDNR cleanup guidelines, additional investigation is required at the B-001BH location. A risk-based evaluation to determine action levels for PAH impacted surface soils at the site is warranted.

8.1.3 Drainage Ditch AOC (AOC-C)

Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-C.

8.1.4 Waste Oil Dump AOC (AOC-D)

Based on the results of the PA/SI conducted, no additional IRP activities are warranted at AOC-D.

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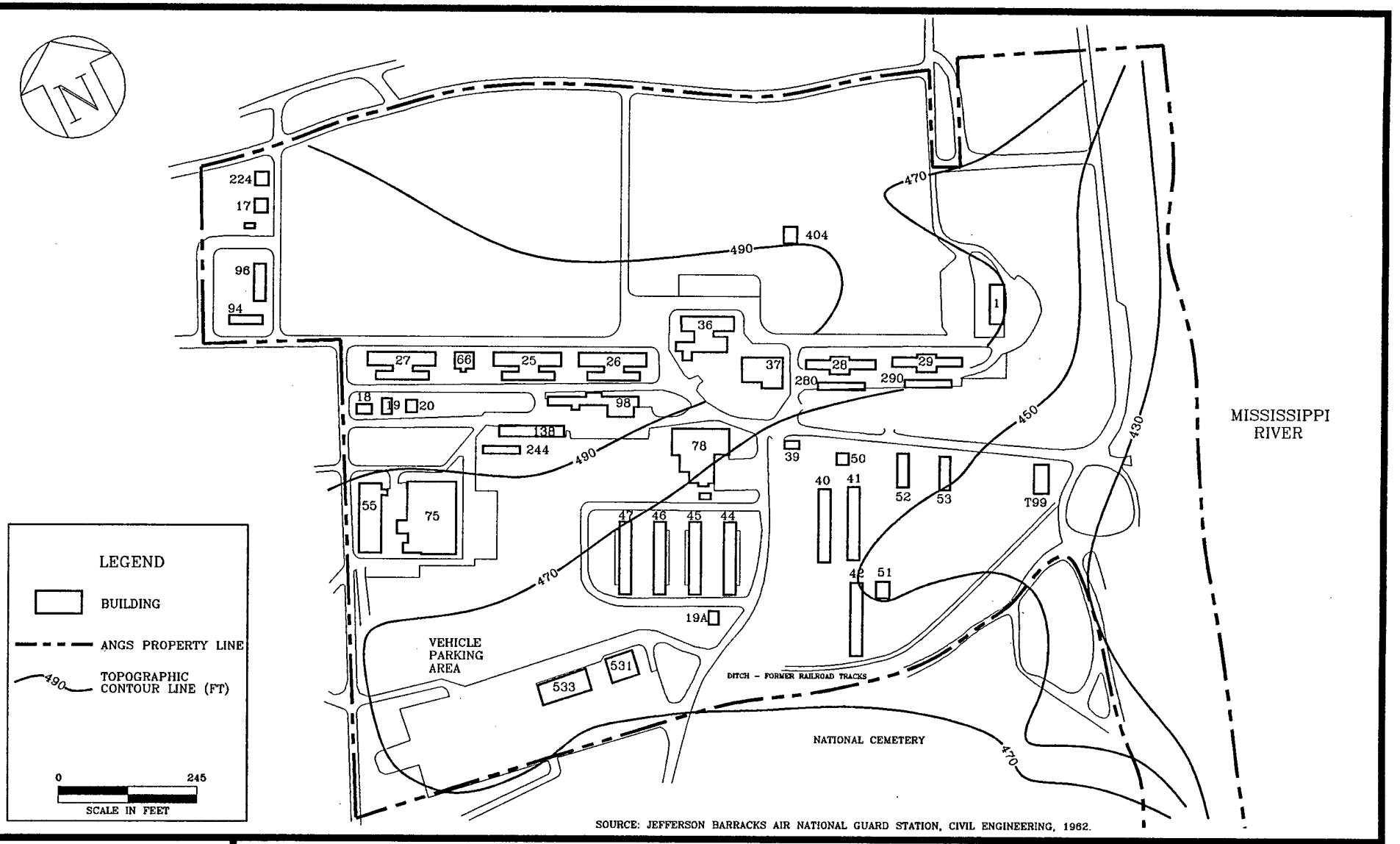

SOURCE: JEFFERSON BARRACKS AIR NATIONAL GUARD STATION, CIVIL ENGINEERING, 1962.

INSIDE BACK COVER

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JEFFERSON BARRACKS ANGS MAP

157th ACG, Jefferson Barracks ANGS

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